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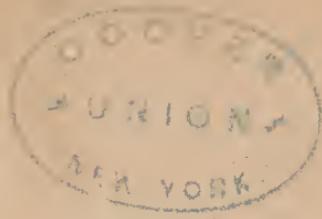












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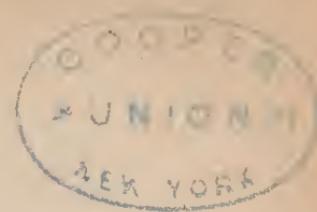
## A DICTIONARY OF TEXTILE FIBRES.

By WILLIAM J. HANNAN,

*Lecturer on Botany at the Ashton Municipal Technical School, Lecturer on Cotton Spinning at the Chorley Science and Art Schools, &c.*

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MEMBER OF THE SOCIETY OF CHEMICAL INDUSTRY; LECTURER AT THE MUNICIPAL TECHNICAL SCHOOL, MIDDLETON; AUTHOR OF "SILK DYEING, PRINTING, AND FINISHING," "DICTIONARY OF COAL TAR COLOURS," ETC.

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## P R E F A C E.

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THIS little book has been written to supply a want which exists for a handbook on the processes employed by the Garment Dyeing and Cleaning Trades. As it is practically impossible for any one to write a work which will cover every case of dyeing and cleaning that may arise in the course of practice, the writer has endeavoured to lay down those Principles which underlie the arts under consideration, and to give some idea how those principles are applied in practice, so that a practical man may, when work of a character such as he has not previously had comes under his notice, be able to undertake that work satisfactorily by means of following up the suggestions he may find embodied in the book.

Every care has been taken in compiling the Recipes given for the Bleaching and Dyeing of various fabrics, in order that these shall be thoroughly reliable, and yield the results indicated; in doing so, the author has drawn largely on his practical experience in the treatment of the different materials. Still, knowing the difficulties that present themselves in the application of recipes in practical working, due to unforeseen differences in the mode of manipulation, as well as to differences which exist between various samples of what are, nominally, the same materials,

the author would point out to his readers that they may not always in the first instance obtain a satisfactory result. Nevertheless, perseverance, with the exercise of a little care in working, will finally ensure success.

With the object of making the book as serviceable as possible, a Glossary of the Drugs and Chemicals used in the trade, Thermometer and Hydrometer Tables, &c., have been added; and the author trusts that although the work is primarily intended for the garment dyer and cleaner, yet that the ordinary cotton, wool, and silk dyer will find in it useful information and hints bearing on his art.

His thanks are due to Messrs. Manlove, Alliott & Co., Messrs. Watson, Laidlaw & Co., Messrs. T. Bradford & Co., and other firms for Illustrations of the most recent types of Machinery employed in Dyeing and Finishing.

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#### PREFACE TO THE SECOND EDITION.

OPPORTUNITY has been taken of the issue of a new Edition of this little handbook to make some material additions to it, particularly in the sections relating to Dyeing and Cleaning Machinery. The author's thanks are due to Messrs. David Gorrie & Son, of Perth, for much valuable assistance.

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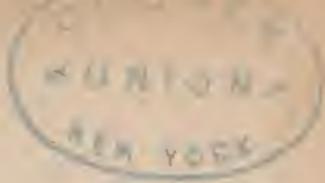
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# GARMENT DYEING AND CLEANING.

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## CHAPTER I.

### THE TECHNOLOGY OF THE TEXTILE FIBRES.

TEXTILE fabrics, whether used for clothing or decorative purposes, are made from a variety of fibrous material derived from both vegetable and animal sources, such as flax, cotton, hemp, jute, ramie, wool, silk, alpaca, &c. Some of these have been used for making woven fabrics from time immemorial; others, such as jute, ramie, alpaca, have only been applied to such purposes during recent times. There is scarcely any limit to the fibrous material which may be used for this purpose; the only condition that fibres must possess seems to be that if they be short, like cotton or wool, they shall possess a scaly structure like wool or a twisted structure like cotton which will enable the various fibres to become firmly united together in a spinning process to form the thread. Fibrous bodies of a short length which are quite smooth cannot be spun into a strong and substantial thread. Smooth fibres of great length, like silk, can be used in weaving textile fabrics.

To make a woven fabric from any of these fibres they are spun by suitable machinery into threads of various degrees of fineness, an operation known as spinning, or throwing in the case of the silk manufacture; these threads are then woven in a loom into cloth. In a piece of woven fabric there are two sets of threads—one set lies parallel with the length of the cloth and is known as the warp threads; the other set lies across the warp threads, with which they intertwine, and so form a piece of cloth. These cross threads are known as the weft threads. In some kinds of woven fabrics, carpets, plushes, there may be more than one set of warp threads or there may be more than one set of weft threads. The warp and weft threads of a fabric may be formed of one kind of fibre, all wool, all silk, or all cotton, for instance; or they may be of different fibres, thus gloria silk is made with a silk warp and wool weft, satin has a silk warp and cotton weft; while some fabrics are made with a cotton warp and wool weft;

and other fibres are used in special kinds of fabrics. The fabrics may be plain in texture, where the warp and weft threads cross each other at regular intervals, or they may be so woven as to produce designs of various kinds; these designs may be made more prominent by each set of threads being dyed in different colours.

As the methods of scouring, bleaching, and dyeing of these various fabrics depend greatly upon the kind or kinds of fibres of which they are composed, it is very important to have a knowledge of the chemical composition, constitution, and the reaction of various chemical agents on these fibres.

### I. VEGETABLE FIBRES.--COTTON.

Of all the vegetable fibres cotton is by far the most important. Its use in the preparation of textile fabrics dates back to at least 445 B.C., if not much earlier; Herodotus mentions it in his writings; the Hindoos were probably the earliest weavers and wearers of cotton fabrics, while the Chinese were also familiar with it, and Pliny describes the Egyptians as wearing stuffs made from cotton.

Cotton consists of the hairy fibre surrounding the seeds of the various species of cotton plants, *Gossypium*, a genus of plants belonging to the natural order of *Malvaceæ*, or Mallow worts. The seeds of the cotton plant are enclosed in a capsule; when ripe this bursts open and the mass of fibre shows itself as a mass of snowy down. The cotton is collected, and the seeds separated from the fibres by a process of "ginning;" the fibre is sold for manufacture into cloth, while the seeds are used for the manufacture of cotton seed oil, a body very largely used in soap making and for food.

Botanists are not quite agreed as to the exact number of species of the cotton plants, but at least there are four principal varieties from which the cotton of commerce is principally obtained, these are—

1. *Gossypium barbadense*, the most valuable, yielding as it does the best cotton known, the Sea Island Cotton; from this and the variety *hirsutum* grown in the United States is obtained the larger quantity of American cotton. The true Sea Island plant bears a yellow flower, while the *hirsutum* variety has flowers varying from a white to a faint yellow.

2. *Gossypium Peruvianum* is a native of South America, flourishing principally in Peru, Brazil, and neighbouring countries. This variety has yellow flowers.

3. *Gossypium herbaceum* differs from the two varieties above named in being a short shrubby plant; it is a native of Asia and is grown very extensively in India, Egypt, China, and other countries; and it furnishes the various varieties of Surat, Madras, Broach, short Egyptian, and other short stapled cottons. It has a yellow flower.

4. *Gossypium arboreum*.—This, as is indicated by its specific name, is a tree-plant, bearing a reddish flower; it grows fairly abundantly in India and China. Its fibre is long and silky, and from it is obtained nearly all the long stapled varieties of Indian, Chinese, and Egyptian cottons.

The cotton fibre is essentially a tube of a more or less spiral shape when viewed by means of a high power microscope (see Fig. 1), which is a drawing of typical cotton fibres, and in which the spiral character of the cotton fibre is well seen. The length of the fibre varies considerably. Evan Leigh in his book on cotton gives the following table showing the average length and diameter of various kinds of cotton fibre :—

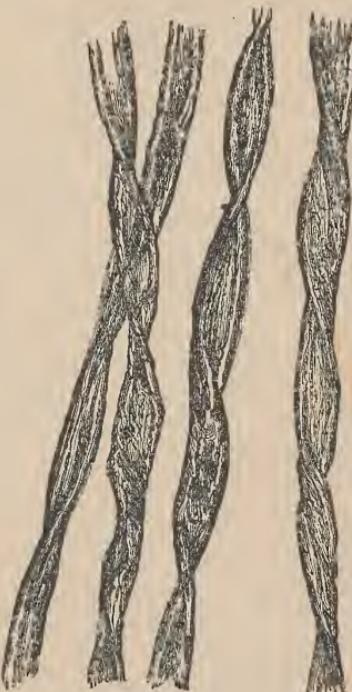


Fig. 1.—Typical cotton fibres.

Description of cotton.	Length of staple in inches.		Diameter of fibre in inches.	
	Min.	Max.	Min.	Max.
New Orleans, . . .	0·88	1·16	0·000580	0·000970
Sea Island (long stapled), . . .	1·41	1·80	0·000460	0·000820
Brazilian, . . . .	1·03	1·31	0·000620	0·000960
Egyptian, : : : .	1·30	1·52	0·000590	0·000720
Indian, . . . . .	0·77	1·02	0·000659	0·001040

The strength of the cotton fibre is fairly great considering its small size; as a rule, those fibres which have the greatest

diameter are the strongest and will resist the greatest amount of strain ; Charles O'Neill gives the breaking strain as ranging from 83·9 grains in Sea Island to 163·7 in Surat cotton.

As will be seen from Fig. 1, the cotton fibre, when viewed under the microscope, appears to resemble a twisted ribbon, the edges of which are thicker than the middle portions ; this twisted appearance is more highly developed in ripe fibres than in unripe ones, and is due to the sap which is in the unripe fibres drying out of the interior, causing the walls of the fibre to collapse and the fibre to become flat and twisted. Ripe fibres, when viewed transversely, show this flat ribbon form with thick edges and the tubular structure of the fibre ; unripe cotton shows, under the same conditions, no evidence of such tubular fibre and appears as a band of uniform thickness. At certain seasons of the year, when the first portions of a new crop of cotton are operated on, these fibres have little or no tendency to become dyed, and in indigo and alizarine dyed cotton cloths they may sometimes be noticed as white specks ; they are, therefore, known as "dead cotton" to dyers.

**CHEMICAL COMPOSITION AND PROPERTIES OF THE COTTON FIBRE.**—Cotton, when freed from small quantities of natural impurities, consists almost entirely of cellulose, a body which is found in every plant, of which it forms the ligneous or woody portion. In the cotton fibre it exists in a purer condition than in any other kind of vegetable fibre ; the impurities in raw cotton rarely exceed 5 per cent., and consist of a little colouring matter, some pectin, a wax, oil, and albuminous matter, all of which can be readily removed from the fibre. In other vegetable fibres the cellulose is accompanied by various mineral incrustations, which are exceedingly difficult to remove. See under *Linen*.

Cellulose is a compound of carbon, hydrogen, and oxygen ; its chemical formula deduced by analysis is, in its simplest form,  $C_6H_{10}O_5$  ; it, therefore, belongs to the group of carbo-hydrates, a group of compounds which contains the elements hydrogen and oxygen in the proportion (2 of hydrogen, H, to 1 of oxygen, O), in which they form water ; this group includes a large number of bodies derived from the vegetable world, such as sugar, starch, dextrine, &c. All these bodies possess what the chemist calls alcoholic properties—that is, they contain an organic radicle combined with hydroxyl, OH, which gives them the property of combining with or being acted upon by acids to form alcoholic salts, for instance, Messrs. Cross and Bevan have lately pointed out, that as cellulose will form a penta-acetyl compound with

acetic acid it must be a penta-atomic alcohol, and will, therefore, have the formula  $C_6H_5(OH)_5$ .

When pure it is a colourless body without taste or odour, almost inert in many of its reactions, while it is quite insoluble in water, alcohol, ether, benzol, and other solvents. It is combustible, burning freely in the air without smell, although smouldering cotton gives off a slight odour of acrolein; there is usually but a small trace of mineral matter.

When treated with an ammoniacal solution of copper hydrate, the cotton fibre begins to swell up and then slowly to dissolve, forming a viscid slimy solution. From this solution acids throw down a thick gelatinous precipitate that, when washed and dried, forms an amorphous white powder having all the properties of cellulose.

**Action of Acids.**—Acids have a more or less powerful action upon cotton, dependent alike upon their nature and strength, as well as upon the conditions of application. Concentrated *sulphuric acid* first causes the cotton fibre to swell up and form a gelatinous mass; if to the mixture water be added a precipitate is obtained known as amyloid. When this amyloid is precipitated upon the fibres of cotton or cellulose it gives them a parchment-like appearance; upon this action of strong sulphuric acid the manufacture of vegetable parchment is based. Paper is passed into strong sulphuric acid for a few seconds, not more than twenty, then well washed with water and dried. If the action of the acid be prolonged cotton is converted into a gum-like body, dextrine, having the same chemical composition as cellulose, but soluble in water and possessing adhesive properties. By boiling the mixture, after dilution with water, the dextrine is converted into glucose, a member of the sugar family.

*Nitric acid* has a very strong but variable action of an oxidising character upon cotton; strength of acid, temperature, time of action, &c., modifying the extent of the action. When hot and strong, nitric acid completely decomposes cotton, converting it into a variety of products, chief among which are oxalic acid and an oxy-cellulose soluble in acids. Cold nitric acid or a mixture of sulphuric or nitric acids have no apparent action on the cotton; at all events there is no change in its appearance, but it has been converted into a series of bodies known as nitro-celluloses, which contain nitrogen in the form of  $NO_2$ , the quantity being dependent upon the time of duration and strength of acids. These nitro-celluloses are valuable products, and are now manufactured on a large scale for a variety of purposes. Hexa-nitro-cellulose is the base of pyroxylin or gun-cotton, and is

a highly inflammable and explosive product. Trinitro-cellulose is not explosive nor so inflammable as the last; it is soluble in a mixture of alcohol and ether, the solution being known as collodion, which is used very largely in photography. On evaporation of the solvent the nitro-cellulose is left behind as a horny, insoluble transparent mass. Other nitro-celluloses have been used for making an artificial silk.

Strong *hydrochloric acid* has a disintegrating action on cotton, converting it into a product which forms a white powder when dry. Hence cotton should never be treated with strong acids.

Dilute mineral acids have but little action on cotton if the time of treatment be short; much, however, depends upon the degree of dilution, especially as regards the action of sulphuric and nitric acids; when these are comparatively dilute they have no visible action for a short time; if moderately strong then they affect the cotton more or less. But even dilute acids have a disintegrating action on cotton if the time of action be too prolonged. If cotton impregnated with dilute acid be dried, then the evaporation causes the acid to become strong and the fibre becomes tendered so much that when dry it will fall into powder; on this re-action depends the process of carbonising or separating cotton from wool in the woollen manufacture.

**Action of Alkalies.**—Alkaline bodies have a different kind of action on cotton. The alkaline carbonates and all weak alkaline bodies, such as soap, borax, ammonia, phosphate of soda, &c., when boiled with it, have no action whatever; hence these may be used for the purpose of scouring or cleansing all kinds of cotton fabrics, even the most delicate, without damaging them.

Cotton may be boiled with dilute caustic alkalies without any effect, provided air be excluded by keeping the goods well under the surface of the liquid; but if any part be exposed to the air during the operation of boiling then the alkali tends to convert the cotton into oxy-cellulose and the fibre becomes tendered. This is sometimes the cause of defects in bleaching. Mercer showed years ago that strong solutions of caustic soda have a very peculiar chemical and physical effect on the cotton fibre. When treated with solutions of a density of from 45° to 50° Twaddell, the cotton swells a little, shrinks in length, and becomes more transparent; at the same time the fibre gains something in strength and in weight.\* Mercer considered that

\* Recently, through the work of Lowe, Thomas, and Prevost, it has been discovered that if the cotton be stretched during the process of treating with caustic soda it does not shrink, but acquires a silky lustre; a large quantity of silky mercerised cotton is now produced, and used for weaving fancy fabrics.

the cellulose forms with the alkali a soda-cellulose, which when washed loses its alkali but forms a hydro-cellulose. Cotton thus treated is known as mercerised cotton, and it has acquired the properties of an increased affinity for many colouring matters, especially the dyestuffs of the Congo group, for basic colours, for alizarine colours, and for tannin substances. Mercerised cotton, notwithstanding its greater strength and greater affinity for dyestuffs, has not come into general use, although it is applied in a few special cases.

**Action of Metallic Salts.**—Metallic salts, like alum, ferrous sulphate, chrome alum, lead acetate, sodium sulphate, magnesium sulphate, &c., when in solution have little or no action on cotton. If cotton impregnated with such solutions be dried the cotton is more or less disintegrated. This appears to be due to one or two causes, either the salt is of such a character that on drying there is a certain amount of decomposition into base and acid, a decomposition which is increased by the presence of the cotton; the acid then exerts a destructive action on the cotton fibre. Or in the case of more stable salts, as, for instance, with sodium sulphate, the drying causes the salt to crystallise, and the crystals forming in the substance of the cotton fibre swell or burst it, and so brings about the destruction of the cotton. Some metallic salts, alum, alumina sulphate, ferric sulphate, &c., have the property of forming basic salts; cotton causes a decomposition of these into free base, which becomes fixed on the fibre, and neutral or normal salt, which remains in solution; this property is taken advantage of in the process of mordanting cotton.

**Action of Oxidising Agents.**—Oxidising agents, like bleaching powder, chlorine, chromic acid, permanganate of potash, have the property of acting on cotton and converting it into oxy-cellulose; if this action proceeds too far then the cotton becomes tender and rotten. Oxy-cellulose has the interesting property of having a direct affinity for the basic coal-tar colours like Magenta, Methylene blue, Violet, &c. Care has, therefore, to be taken in the use of bodies of this nature during the operation of bleaching cotton; used in quantities sufficient to destroy the colouring matter or for a short time only, and too weak in character, they will not materially affect the cotton; on the other hand, if used too strong, or their action is too prolonged, they will ultimately destroy it.

**Action of other Substances.**—Cotton has a strong affinity for tannin; advantage is taken of this fact for the purpose of mordanting cotton with either tannin or tannin materials, like

sumach, divi-divi, chestnut, &c., for dyeing with the basic colours.

Cotton has but little affinity for colouring matters. With a few of the natural dyestuffs, indigo, turmeric, safflower, and annatto it will unite directly. Of the coal-tar colours cotton has no affinity for the acid and azo colours in general with, perhaps, the Croceines as an exception. Of the basic colours Safranine and Methyl violet are the only ones which possess any sort of affinity for cotton, and even these will only produce pale shades; for the so-called Congo or Direct Cotton colours, of which Congo red was the first commercial representative, cotton has a very powerful affinity, and with these dyestuffs produces some very deep and fast shades. What particular feature in the composition of these colours gives them this property of direct combination with cotton is not yet satisfactorily explained.

### LINEN.

Linen is a product of the flax plant, *Linum usitatissimum*. Next to cotton it is the most important of the vegetable textile fibres. It grows fairly luxuriantly in countries with a temperate climate, and is cultivated in Ireland, Holland, Russia, the Northern parts of India, Canada, America, &c. This plant is a very useful one, its seed forming the familiar linseed so useful in medicine and as the raw material for the manufacture of linseed oil, an oil of great service to painters, while the residual cake left after extracting the oil is used as a food stuff for cattle.

The flax fibre is obtained from the stem of the plant by a process known as "retting," which consists essentially in steeping the plant in water; a process of fermentation sets in, much of the mucilaginous, pectous, and mineral matters which accompany the fibre are rendered soluble and pass away, leaving the fibre in a free condition, or at least only accompanied by some woody fibre from which it is freed by the process of scutching. Flax is thus obtained in two forms, "line" and "tow"; the former consists of the long silky fibres, the latter of the shorter and more tangled fibres.

**PROPERTIES.**—Linen, like cotton, consists essentially of cellulose. The ultimate fibres of flax vary from 0·75 to 1·25 inch in length and from 0·00048 to 0·00104 inch in diameter; the latter is, however, exceedingly uniform and rarely varies much from 0·0006 inch. In the flax line a large number of these fibres are found united together in one long thread of some considerable length, two to three feet. Viewed under the micro-

scope the flax fibre is seen to have the form of long cylindrical tubes terminating in a cone at each end ; the cell walls are very thick, so that the central tube usually only shows itself as a thin black line. At intervals the fibres are slightly distended, while under high powers transverse markings become visible. It is possible that the fibre may be made up of a number of fibrets united together. Fig. 2 is a drawing of the flax fibre.

Linen consists essentially of cellulose accompanied in the raw fibre with a large proportion of impurities, some 20 to 30 per cent. It is very difficult to free it from some of these impurities, hence the operation of bleaching linen is a more tedious process and a stronger treatment is given to it than is the case with cotton. In its general behaviour towards chemical reagents linen closely resembles cotton ; it is soluble in ammoniacal copper solution ; sulphuric acid imparts to it a blue colour as also does iodine. In dyeing, linen is treated much in the same way as cotton, it having much the same kind of affinity but is rather more difficult to dye, a difference perhaps due to the different physical structure of the two fibres, cotton (owing to its more tubular structure) having greater absorbent properties ; on the other hand, a part of the greater difficulty may be due to the pectous principles with which linen or flax is associated and which may tend to retard its dyeing properties. Linen differs from cotton in being a better conductor of heat ; on this account linen fabrics always feel colder than cotton fabrics. It is stronger and possesses a lustre wanting in cotton.

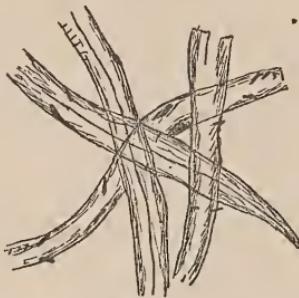


Fig. 2.—The flax fibre.

### HEMP.

Hemp is the name given to the fibres from the stem of the hemp plant, *Cannabis sativa*, which grows in all temperate climes. It is cultivated in many countries on account of its fibre and also for its seed which is used for extracting an oil from. From the stems of the plant the hemp fibre is obtained by a process of retting, &c., as is done with linen. It is used for making sacking, canvas, ropes, &c., for which purposes it has some valuable properties, such as being strong and not easily rotting when immersed in water. It is a very coarse fibre, so

that it is only used for fabrics which may be used in the rough state ; it is, therefore, rarely, if ever, bleached or dyed ; when required these operations are carried on by the same processes as are used for linen or cotton.

The hemp fibre closely resembles that of linen ; if anything it is more scaly in appearance, longer and wider.

### JUTE.

The fibre of the jute is derived from various species of *Corchorus* plants, natives of India, which have of late years become of considerable importance in the manufacture of textile fibres, especially of carpets, matting, sack cloth, canvas, &c. The most important species of jute plant is the *Corchorus capsularis* which is extensively cultivated in India, from whence comes by far the largest supplies of jute fibres.

The stems of the plant are retted by steeping in water ; the fibres are comparatively easily removed in a fairly pure condition ; their length is about  $1\frac{1}{2}$  to  $2\frac{1}{2}$  yards, of which about a foot is cut off and used in making paper, the rest being spun into thread and woven into various kinds of jute fabrics.

**PROPERTIES.**—The jute fibre in its ultimate form has a length of 0·03 to 0·17 inch and a diameter of 0·0004 to 0·0013 inch. The fibres have a more or less polygonal appearance, being usually five- or six-sided, and a central canal of a very small size which is often scarcely visible ; otherwise the appearance of the fibre resembles that of linen.

Jute differs from cotton, linen, and hemp in its chemical composition. According to Messrs. Cross and Bevan, who have made a very exhaustive examination of the jute fibre, it consists not of cellulose but of a combination of cellulose with another body of similar nature to which the name of bastose is given. This combination of the two bodies has been named by Messrs. Cross and Bevan—*Corchorobastose*. This causes the jute fibre to possess properties very different from those of purely cellulose fibres, which are in the main more nearly like those possessed by woody fibre. Sulphuric acid and iodine colour it a dark brown ; sulphate of aniline imparts a yellow colour. A fine crimson colour is developed when the fibre is first treated with chlorine and then with bisulphite of soda, a reaction which resembles that given by cotton which has been treated with tannin. Chlorine and bromine have the property of combining readily with the jute fibre, disintegrating it ; therefore, the process of bleaching with chlorine or bleaching powder, which is so success-

ful with cotton and linen, cannot be followed to so great an extent in bleaching jute. Sulphuric acid, either strong or dilute, has a tendering action on jute, rendering it more brittle; so that it does not spin or weave easily, although the fibre so treated has a more silky appearance than fibre which has not been acted upon by the acid.

Jute differs from all, or nearly all, other vegetable fibres by its possessing a natural affinity for the basic coal tar colours, which, therefore, do not require the jute to be previously mordanted with tannin as is the case with cotton or linen. It has also some affinity for the acid coal-tar colours and with many of these it may be dyed from a bath containing sulphuric acid or preferably alum.

Jute has a similar action on metallic salts as cotton, but in a greater degree; so that it is rather more readily mordanted with salts of alumina, iron, &c., than is the case with the other vegetable fibres.

When jute is placed in a weak solution of ferric ferricyanide (prepared by mixing solutions of ferric chloride and potassium ferricyanide together), it becomes dyed of a more or less deep Prussian blue colour, a reaction which is fairly characteristic of this fibre.

#### CHINA GRASS.

China grass, or, as it is sometimes called, Rhea or Ramie fibre, has come into great prominence of late years as a textile fibre. It is obtained from the stems of a species of nettle plant, *Baehmeria nivea*. This plant is largely cultivated in China, India, and other Asiatic countries. The fibres are, as in flax, hemp, and jute, situated between the stem and the bark, but unfortunately they cannot easily be separated from these two portions of the plant; retting with water, which is adopted with the other fibres named, is not suitable, inasmuch as it causes the fibres themselves to become disintegrated into their ultimate fibre constituents and then cannot be separated from other portions of the plant. The fibres are usually obtained by taking the plant or its stem while in a green condition and passing it through a machine, which, by breaking up the stem and bark without affecting the fibres, causes the latter to be easily separated by washing with water. The China grass fibres attain a length of  $1\frac{1}{2}$  to 2 yards, and possess a fine silky appearance. The ultimate fibres of the China grass have a length of about 1 inch and a diameter of 0.0016 to 0.0032 inch. The fine silky lustre is, unfortunately, easily affected by dyeing processes.

China grass consists essentially of cellulose mixed in the raw fibre with some pectous matter, &c. In its general properties it closely resembles cotton. It is easily bleached to a fine white colour. For dyes it has about the same affinity as cotton, that for the basic colours being, perhaps, rather stronger. It can be readily dyed, but there is a great risk of its losing its silky lustre.

### OTHER VEGETABLE FIBRES.

Other vegetable fibres are known and used more or less locally in the countries where they are grown, as, for instance, New Zealand flax, the fibre of *Phormium tenax*, Manila hemp, cocoa-nut fibre, agave fibre, &c., these are of so little importance, and the information about them is of so scanty a nature, that it is not necessary to notice them more fully here. Perhaps it will be sufficient to say that, should dyers have occasion to deal with any of these fibres, they can be treated in a similar manner to linen or jute, New Zealand flax and cocoa-nut fibre more nearly resembling the latter fibre in their dyeing properties than linen.

**CLASSIFICATION.** — Vegetable textile fibres may be roughly divided into two classes. The first class comprises those which are, like cotton, found attached to the seeds of various plants ; these consist almost entirely of cellulose, and in all their properties resemble cotton ; if they have, like cotton, a twisted structure, then they may be used in the preparation of textile fabrics ; but often they are quite smooth and will not spin into a substantial thread. The second class of textile fibres are those which, like linen, hemp, and jute, are found in the stem portion of the plant lying between the woody portion of the stem and the bark ; these are known as bast fibres ; they do not consist entirely of pure cellulose, but often contain lignocellulose or a body known as bastose ; the presence of these bodies causes them to possess different affinities for metallic salts and dyes to what the pure cellulose fibres have, as will have been noticed from the descriptions already given.

Consisting as vegetable fibres do essentially of cellulose it is a difficult matter to differentiate between the different fibres, especially those which are formed of bast fibres. Jute may be distinguished by its giving a golden yellow colour with sulphate of aniline, while cotton and linen do not ; sulphuric acid and iodine do not colour cotton, while they impart a blue colour to linen and a brown colour to jute. Jute is dyed an intense

blue by ferric ferricyanide, linen a pale blue, but cotton is not coloured.

## II. ANIMAL FIBRES.

There are three kinds of animal fibres met with in nature and used in the manufacture of textile fibres; two of these are derived from quadruped animals, such as the sheep, goat, &c.; while the third class comprises the products of certain insects—*e.g.*, silk.

All animals have a more or less fibrous coating, which serves as a sort of protecting coat from the weather to the skin underneath; this coat of fibre may consist wholly of woolly fibres or partly of woolly fibres with some short stiffer fibres called hairy fibres; occasionally in certain parts of the body these hairy fibres may grow to a great length. Of these two classes of animal fibres the woolly fibres are the most esteemed for the manufacture of textile fabrics; it is only when the hairy fibres are long that they are serviceable for this particular purpose. There is a slight difference in the structure of the two kinds of fibre, woolly fibres having a more scaly structure than hairy fibres, the latter also differ in being more cylindrical in form.

### WOOL.

By far the most important of the animal fibres is wool, the fibre of the domestic sheep. Other animals, the llama or alpaca, the Angora and Cashmere goats, also yield fibres of a similar character, which are imported under the name of wools. There are many varieties of wools yielded by the various breeds of sheep, but they may be roughly divided into two kinds according to the length of "staple," as it is called. In the long stapled wools the fibres average from  $7\frac{1}{2}$  to  $9\frac{1}{2}$  inches in length, while the short stapled wools vary from 1 to 2 inches long. The diameter varies very considerably from 0.00033 to 0.0018 of an inch. Two varieties of thread are spun from wool; one is known as "worsted," the other as "woollen" yarns; from these yarns two kinds of cloths are woven, distinguished as worsted and woollen cloths; the former are in general not subjected to any milling or felting process, while the latter invariably are.

**PHYSICAL PROPERTIES.**—When seen under the microscope the wool fibres show a rod-like structure covered with broad scales, the edges of which project from the body of the fibre and all point in one direction. The shape of the scales

varies in different breeds of wool; this structure is shown in Fig. 3, which represents the structure of various kinds of wool fibres. The outer scales enclose inner medullary cells which often contain pigment matter. A transverse section of the wool fibre shows the presence of a large number of cells; Bowman computes them at 1,500. Certain wool fibres are occasionally met with which have a peculiar white horny appearance, those do not felt or dye well. They are known as "kempy" fibres. The microscope shows that they are devoid of structure and are

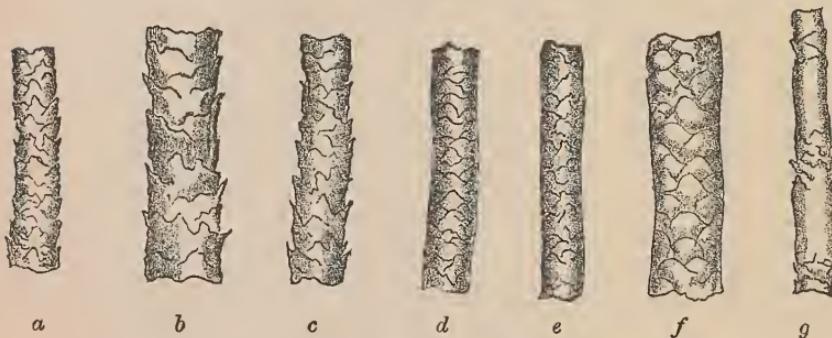


Fig. 3.—Microscopical appearance of various wool fibres.

- a*, Fine merino. *b*, Lincoln wool taken from the coarsest part of the fleece after treatment with caustic soda and washing with alcohol and water. *c*, Lincoln wool taken from the shoulders of the same fleece as *b*. *d*, Alpaca. *e*, Mohair. *f*, Coarse hair from Cheviot fleece. *g*, Kempy fibre.

formed of very horny, impenetrable tissue, which is difficult to treat in the milling or dyeing process. The scaly structure of wool is of great importance in regard to what is known as the felting property. When woollen fabrics are worked in boiling water, especially in the presence of soap, they shrink in length and breadth, but become thicker in substance, while there is a greater amalgamation of the fibres of the fabric together to form a more compact and dense cloth; this is due to the scaly structure of the wool fibres, enabling them to become entangled and closely united together. In the manufacture of felt hats this is a property of very great value.

Wool is a much more hygroscopic fibre than cotton or any of the other vegetable fibres; usually it contains about 18 per cent. of water, but much depends upon the atmospheric conditions prevailing. This water is contained in the wool in two

forms—(1) as water of hydration amounting to about 8 per cent., and (2) as hygroscopic water. Heated to about 100° C. it parts with nearly the whole of its water and becomes hard, horny, and brittle; exposed to the air the dry wool again absorbs water and is restored to its former condition. When heated to 100° C. wool becomes somewhat plastic, so that whatever form is then imparted to it, it will retain when it becomes cold; this property is very useful in certain processes of finishing wool fabrics. If a piece of wool be held in a flame it appears to fuse and run into a black coloured bead, burns with difficulty, and emits a peculiar odour; this serves to distinguish wool from cotton or other vegetable fibres.

**CHEMICAL PROPERTIES.**—**Action of Alkalies.**—Alkalies have a powerful action on wool, varying of course with the nature of the alkali, strength of solution, and temperature at which the action takes place. An ammoniacal solution of copper hydroxide (Schweitzer's reagent) has comparatively little action in the cold, but when hot it dissolves wool fairly readily.

The caustic alkalies, *sodium hydroxide*, NaOH, or *potassium hydroxide*, KOH, have a most deleterious action on wool; even when very dilute and used in the cold they act destructively, and leave the fibre with a harsh feel and very tender; they cannot, therefore, be used for scouring or cleansing wool. Hot solutions, even if weak, have a solvent action on the wool fibre, producing a liquid of a soapy character from which the wool is precipitated out on adding acids. The *alkaline carbonates* have but little action on wool; none if used dilute and at temperatures below 120° F.

*Soap* has practically no action on wool, and is, therefore, an excellent scouring material for wool. The *carbonate of ammonia* is the best and has the least action of the alkaline carbonates; those of *potash* and *soda*, if used too strong or too hot, have a tendency to turn the wool yellow; the carbonate of potash leaves the wool softer and more lustrous than the carbonate of soda. The influence of scouring agents on wool will be discussed in the chapter on cleansing fabrics.

*Caustic* or *quicklime* has a similar injurious action on the wool fibre as the caustic alkalies.

**Action of Acids.**—Acids when dilute have but little influence on the wool fibre; their tendency is to cause a separation of the scales of the wool and so make it feel harsher. Strong acids have a disintegrating action on the wool fibre. There is a very considerable difference between the action of acids on wool and on cotton and this difference of action is taken

advantage of in the woollen industry to separate cotton from wool by the process commonly known as "carbonising," which consists in treating the fabric with a weak solution of *hydrochloric acid*, then drying it; the cotton is disintegrated and falls away in the form of a powder, while the wool is not affected. *Sulphuric acid* is used very largely in dyeing wool with the acid and azo colouring matters.

*Nitric acid* affects wool in a very similar manner to the acids named above; if strong it gives a deep yellow colour and acts somewhat destructively on the fibre; when dilute it does not affect the fibre so much, but still imparts a yellow colour varying in depth according to the strength of acid used. Nitric acid is largely used in garment dyeing to destroy any colour which garments may have before re-dyeing them. The acid should not be used stronger than 4° to 5° Tw., or the strength of the wool will be affected.

*Sulphurous acid* (sulphur dioxide) has no effect on the actual fibre, but exercises a bleaching action on the yellow colouring matter which the wool contains; it is, therefore, largely used for this purpose, being applied either in the form of gas or in solution in water; the method will be found described in another chapter.

**Action of other Substances.**—*Chlorine* and the *hypochlorites* have an energetic action on wool, and, although they exert a bleaching action, they cannot well be used for bleaching wool. Hot solutions of bleaching powder entirely destroy the fibre. Weak and cold solutions bring about a slight oxidation of the fibre, which causes it to have a greater affinity for colouring matters; advantage is taken of this fact in the printing of Delaines and woollen fabrics, while the woollen dyer would occasionally find the treatment of service. A paper by Mr. E. Lodge in the *Journal of the Society of Dyers and Colourists*, 1892, p. 41, may be consulted with advantage on this subject.

When wool is boiled with solutions of *metallic salts*, such as the sulphates of iron, chrome, aluminium, and copper, the chlorides of tin, copper, and iron, the acetates of the same metals, as well as with some other metallic salts, it exerts a reducing action, with the result that there is a deposition of the metallic oxide on the wool, and the production of an acid salt which remains in solution. In some cases this action is favourably influenced by the presence of some organic acid or organic salt, as, for examples, oxalic acid and cream of tartar (potassium tartrate) along with the metallic salt. On this fact depends the process of mordanting wool with potassium bichromate, alum, alumina

sulphate, ferrous sulphate, copper sulphate, &c. The exact nature of the action which occurs is somewhat uncertain, but there is reason for thinking that the wool fibre has the capacity of assimilating both the acid and the basic constituents of the salt employed.

The normal salts of the alkaline metals, such as sodium chloride, potassium sulphate, sodium sulphate, &c., have no action whatever on the wool fibre.

Wool has a strong affinity for many *colouring matters*. For some of the natural colours, turmeric, saffron, annatto, &c., and for the neutral and basic coal-tar colours it has a direct affinity and will combine with them from their aqueous solutions; Knecht has shown that the active principle of the wool fibre has a decomposing action on the basic colouring matters, combining with the base to form a coloured body, while the acid constituent is liberated in the free condition. For the acid and azo colouring matters, indigo extract and some others, wool has a strong affinity, if the colour-acid they contain be previously liberated by the addition of a little strong acid, such as sulphuric, hydrochloric, or acetic acids. Wool is of a very permeable character, so that it is readily penetrated by dye liquors; in the case of wool fabrics much depends, however, upon the amount of felting to which the fabric has been subjected.

Wool is essentially a nitrogenous product; it contains not one body only but a number of products. Knecht has isolated one of these and named it *lanuginic acid*; it has the property of combining with colouring matters and mordants to form insoluble, more or less coloured bodies. Besides this, wool possibly contains other bodies of an amido-acid nature which impart to it the property of combining with either acids or bases, a property of very considerable value in dyeing wool.

The other varieties of wool differ only from sheep's wool in the form of their fibre. As regards their chemical composition, action of acids, alkalies, dyeing properties, &c., they closely resemble sheep's wool, differing a little in the degree of their action on those bodies; thus mohair is a little more difficult to dye than wool.

### SILK.

Silk is the name given to the fibrous material secreted by the caterpillars of certain moths to form the cocoon which encloses them during their transition period, the chrysalis, between their caterpillar and imago stages. The silks which are used in the textile arts may be roughly divided into two groups, domestic

or cultivated and wild silks. The former is by far the most important; it is chiefly obtained from the caterpillar of the

silkworm moth, *Bombyx mori*. Fig. 4 represents the moth in the various stages of its existence. This moth, in its caterpillar stage, feeds on the leaves of the mulberry tree, and hence the silk is sometimes distinguished as "mulberry silk." It is largely cultivated in Italy, Japan, China, India, and other localities. The silk worm has glands on each side of its body which secrete a peculiar fluid; this passes out of the spinneret at the end of the caterpillar and then solidifies to form the silk fibre, which may vary from 400 to 2,000 yards in length and average about 0.00067 of an inch in diameter, the fibre having the largest diameter at the outside of the



Fig. 4.—The silk moth.

cocoon and the narrowest in the centre. The fibres from a number of cocoons are reeled together to form a single thread, and it is in this form that the silk fibre makes its appearance in the market. Organzine or warp silk thread is thicker and has more twist about it than is the case with weft or tram silk. *Floret silk* is the name given to the fibres from the centre of the cocoon. *Spun silk* is the name given to the silk thread obtained from loose fibres, damaged cocoons, &c., by boiling off, carding and spinning the threads as in the cotton or wool industry; while *chappe silk* is made in a similar way from fibres which have not been boiled off.

The silk fibre consists essentially of two portions, an outer coating, more or less coloured, of a gummy substance, the *sericin* or silk gum, and an inner portion, the silk fibre proper or *fibroin*. The silk gum can be removed by boiling the fibre in

weak solutions of alkalies, or of soap ; this process constitutes the operation of boiling off, during which there is a loss of from 25 to 30 per cent. of the weight of the raw fibre, but the latter is left more pliable, softer, and lustrous. Viewed under the microscope the silk fibre is seen to be formed of two fibres

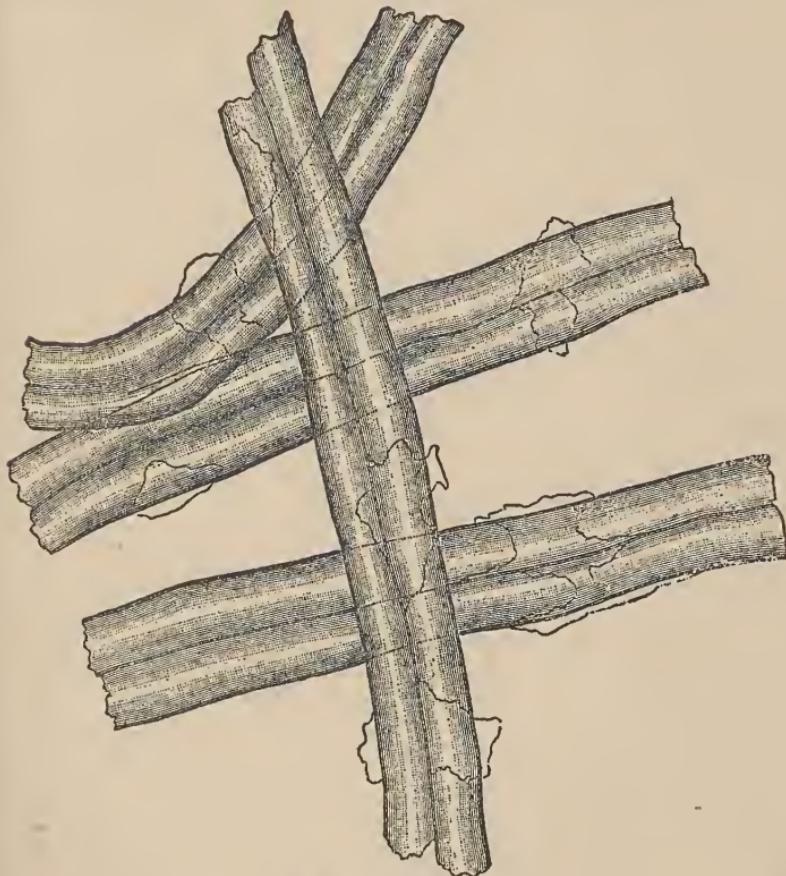


Fig. 5.—Silk fibres.

cemented together side by side by the silk gum or sericin (Fig. 5) ; these fibres do not appear to possess any structure and have a solid rod-like form. When the silk is boiled off and the gum removed, then the two portions of the silk fibre tend to separate from one another. The whole fibre is known in France as the *bave* and each single fibre as the *brin*.

**Action of Acids.**—Acids have some action on silk; the strong mineral acids rapidly attack and disintegrate silk. *Hydrochloric acid* dissolves it easily, taking up more than its own weight of the fibre. *Nitric acid* also dissolves it, a yellow coloured solution being obtained. *Sulphuric acid* dissolves silk to a syrupy liquid. Usually on adding water to these acid solutions a flocculent precipitate is obtained which probably consists of the fibroin of the silk in an altered form.

When silk is immersed in very weak aqueous solutions of acids it rapidly absorbs them and retains them very tenaciously; at the same time the silk acquires additional lustre and a peculiar feel, and the property of giving off a crackling sound when crushed, this is known as the "scroop" of the silk. This action of acids is taken advantage of in dyeing and finishing silk for the purpose of increasing its lustre where the nature of the dye-stuff used will permit of it being done. The operation is known as "brightening" the silk, and is carried out usually by preparing weak solutions of either acetic, sulphuric, or tartaric acids; the latter gives the best results but is not often used on account of its greater cost. Oxalic acid has also been used for this purpose. After being immersed in the acid solution the silk is dried without being washed. When silk is boiled with dilute nitric acid it is coloured yellow, due to the formation of what is known as xanthoproteic acid. Hot strong acetic acid will dissolve silk.

**Action of Alkalies.**—Alkaline solutions have a very variable action on silk, dependent upon the strength and temperature of the solution. At low temperatures *caustic soda* and *potash* solutions have little action, even if used of such strengths as would mercerise cotton; hot solutions dissolve silk, and among the products thereby formed is sericinic acid which has analogous properties to the lanuginic acid from wool. Although the caustic alkalies when in weak solution may be used for discharging silk, yet owing to their solvent action on the fibroin it is not advisable to use them. The *alkaline carbonates* have a similar action to the caustic alkalies, but act less energetically.

*Ammonia* has but little action and may be used as a scouring agent for silk. *Lime water*, when the action is prolonged, destroys the lustre and reduces the strength of the fibre.

*Soap* and *borax* have no action whatever on silk and may be used for boiling off or discharging or scouring silks without any fear of spoiling the material.

**Action of other Substances.**—Silk has a decomposing action

on solutions of many *metallic salts*, resembling wool in this respect. This property is applied in the dyeing and weighting of silk goods. Thus if silk is immersed in a solution of basic ferric sulphate, the so-called nitrate of iron, for some time, the iron salt is absorbed by the silk, and on subsequent washing with water the iron is found deposited on the silk as oxide. Solutions of alum, alumina sulphate, chrome alum, stannous and stannic chlorides, when in a more or less basic condition, are affected in a similar manner. Strong solutions of zinc chloride and stannic chloride dissolve the silk, hence it is very important that these two bodies be used with great care. Silk is soluble in Schweitzer's reagent (ammoniacal solution of copper). Solutions of bichromate of potash colour silk yellow, or, if the silk be subjected to prolonged boiling in such solutions, it may become of an olive yellow colour; bichromate of potash is not available as a mordant for silk. Chromic acid decomposes the silk fibre. Potassium permanganate is decomposed and a brown deposit of manganese oxide is formed on the silk; this deposit can be removed by treatment with sulphurous acid or bisulphite of soda with the result that the silk is bleached. Too strong solutions of permanganate, however, disintegrate the silk. Chlorine and the hypochlorites destroy the silk, therefore they cannot be used for the purpose of bleaching silk fabrics.

As regards its affinity for colouring matters silk closely resembles wool in all particulars, but has, perhaps, a little less energy.

Silk when freed from the sericin and other impurities consists essentially of a nitrogenous substance named fibroin and having a composition corresponding to the formula  $C_{15}H_{23}N_5O_6$ . From investigations and from the known affinities of the silk fibre for colouring matters fibroin must be an amido-acid; therefore it can play the part of either an acid or a base as circumstances will permit it; hence the affinity which silk possesses for both acid and basic colouring matters. Fibroin forms about 70 to 75 per cent. of the raw silk fibre.

Sericin or silk glue has a similar composition to fibroin but contains more oxygen and hydrogen; its formula is  $C_{15}H_{25}N_5O_8$ . It is generally regarded as an hydration product of fibroin, produced when the latter is exposed to the action of the moisture and oxygen of the atmosphere. It can be obtained in the form of a tasteless powder, which swells up in cold water and is a little more freely soluble in hot water than gelatine, yielding thick viscid solutions. From these it is precipitated by the addition of alcohol, tannic acid, or solutions of metallic salts.

### WILD SILKS.

Under the general title of wild silks there comes into the market a number of silk fibres produced by caterpillars of moths whose rearing so far has not been made the object of any industry, as is the case with the mulberry silk moth described above. These are known as "Wild Silks." They come from a great variety of moths which live in various districts of India and contiguous countries ; of some of them but little is definitely known ; one only is as it were made a regular article of commerce, the Tussah or Tussur silk, while the others come into this country in but small lots. Tussah silk is somewhat cheaper than mulberry silk, and, therefore, finds its way into the cheaper classes of silk fabrics.

**TUSSAH** or **TUSSUR SILK** is the most important of the wild silks ; it comes into this country from India and China in

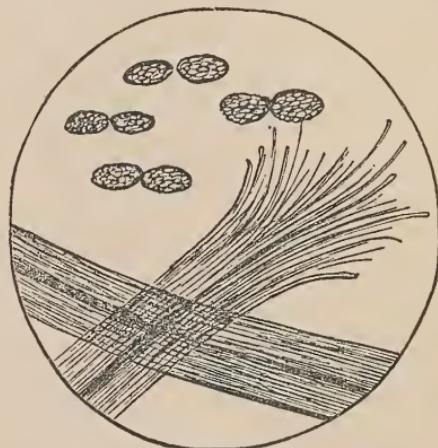


Fig. 6.—Tussah silk fibre.

large quantities, as two varieties of silk, which are not the produce of the same moth, but of allied species. The *Indian tussah silk* is from *Antherea mylitta*, the *Chinese tussah silk* from *Antherea pernyi* ; both, however, belong to the same family of moths. So far as is known the silks of the two moths are identical in composition and structure.

The Tussah silk moth is much larger than the mulberry silk moth and builds a larger cocoon, so that the fibre is much longer ; it has a brownish colour and very peculiar odour. The silk differs markedly from the silk of the mulberry moth ; it is

longer, ranging from 600 to 2,000 yards in length, while the average diameter is  $\frac{1}{600}$  to  $\frac{1}{700}$  of an inch. The fibre is composed of a large number of fibrets having a mean diameter of  $\frac{1}{3000}$  of an inch, which gives the fibre a striated appearance when seen under the microscope. Fig. 6 shows this peculiar structure of Tussah silk. The fibre is not quite round, but often has a flattened ribbon-like form more or less twisted, much in the same way as cotton is.

The chemical composition of Tussah silk is not yet fully established. According to Bastow and Appleyard the raw fibre contains 5·34 per cent. of mineral matter, consisting principally of lime, soda, and potash, with some silica, phosphoric and carbonic acids. It contains 0·91 per cent. of fatty matter and a small quantity of wax. The sericin amounts to 21·33 per cent., although the total loss on boiling in soap and water is 26·49 per cent. The fibroin, freed from all impurities, has the composition—carbon, 47·18 per cent.; hydrogen, 6·3 per cent.; nitrogen, 16·85 per cent.; oxygen, 29·67 per cent. These figures show that Tussah contains less carbon and more oxygen than mulberry silk.

Tussah silk is not so readily acted upon by alkalis as is mulberry silk; a weak solution of caustic soda which would dissolve mulberry silk will not attack Tussah silk. Stronger alkaline liquors may therefore be used in the boiling-off process.

Tussah silk is also more resistant to the action of acids, being only partially soluble in strong hydrochloric acid; in nitric acid it dissolves to a brown liquid; strong solution of zinc chloride has but a slight action on Tussah silk; chromic acid has but a slight solvent action.

As regards its behaviour towards dyeing agents it may be stated that while in the main this resembles ordinary silk yet it is much more difficult to dye, the Tussah silk fibre seeming to have a repellent action and to be more impervious to the dye liquors than is ordinary silk; it, therefore, takes longer to dye Tussah silk than it does ordinary silk. Then, again, it is difficult to bleach Tussah silk; in ordinary silk the natural colouring matter seems to be concentrated on or in the outer coating of sericin or silk glue, and so is easily got rid of in the boiling-off process; on the other hand, with Tussah silk the colouring matter extends right through the fibrillæ of the fibre, and as these are somewhat impervious it is not at all easy to bleach the colouring matter; light tints are, therefore, not by any means so common on Tussah silk fabrics as they are on ordinary silk goods.

Silk fabrics made from other varieties of wild silks are not articles of commerce in this country, although they are collected and used locally where the silk moths are found. Muga silk comes from the Muga moth, *Antherea Assami*, which belongs to the same family as the Tussah silk moth; it is found chiefly in Assam, in Dehra Dun, a small district west of Nepaul, and also in Dhurumpoor in Bombay. In each of these localities the silk is collected and used for weaving fabrics. Muga silk closely resembles Tussah silk in its structure and probably in its properties, about which, however, little is known. Muga silk, when in the raw condition, possesses a somewhat peculiar odour and is not at all pleasant to work with. Eria silk comes from the *Attacus ricini*, a moth which feeds on the leaves of the castor oil plant, and is found in Nepaul, Assam, and adjoining districts in fair abundance. The moth is one of the largest of the silk moths. Its fibre resembles Tussah silk in its structure, the whole fibre being built of fibrillæ; of its composition and properties scarcely anything is known, but it is quite possible that it will resemble Tussah in its main features. Atlas silk is the produce of the Atlas silk moth, *Attacus atlas*, which is found abundantly in Southern India, Ceylon, and other countries. The moth is the largest of the silk moths, specimens frequently measuring 7 to 8 inches from the tip of one wing to the tip of the other. The silk spun by this moth finds some little use in the localities where the moth is plentiful. In appearance and structure it, like the other wild silks, resembles the Tussah silk, and will probably have the same properties. No other wild silks are of any interest.

## CHAPTER II.

## GARMENT CLEANING.

A VERY large business now is the cleaning of garments and textile fabrics of all kinds ; cleaning is also a preliminary operation, before garments or other fabrics are dyed or re-dyed, as the case may be. The nature of this cleansing process will depend partly on the material of which the garments, &c., may be made, and partly on what is required to be done to them afterwards.

Before, however, garments are cleaned they have to undergo certain preliminary operations with a view to preparing them for that process, so that the results may be as good as can be desired ; the nature of these preliminary operations will much depend upon the character and condition of the garments or other goods which are being dealt with. Gentlemen's clothes will require to be well brushed, so as to free them from any loose dirt which may be attached to them ; then any little cut or tear should be mended, as, otherwise, in the process of cleaning such might catch somewhere and the tear be made larger, which is not at all desirable. Ladies' dresses will also require to be brushed ; they may also require to be unpicked, especially if made from a variety of materials, all of which will not dye up in an even manner from the same dye-bath. No general rule can be laid down ; dyers will have to work by the method which their experience directs them will be the best to follow in the particular instance under treatment. If dresses have to be unpicked, great care should be taken that no part of the dress gets misplaced or mixed with some other dresses ; such things have happened at different times, with rather dire results sometimes ; this, of course, is a matter of routine which can be easily arranged.

There are two principal methods of cleaning garments followed in this and other countries. There is the old fashioned, but still serviceable, wet process, where the articles are treated with soap ; while the second process is the so-called dry process, or as the French call it *nettoyage de sec*, where the articles are treated with some solvent, like benzol or petroleum benzine.

Which of these processes is the best to be adopted in any particular case cannot be easily indicated by any general rules; experience and the work required to be done must guide the cleaner in his choice of these two processes. Sometimes the soap method will be found to yield the best and most satisfactory results, at other times the dry process, which perhaps, on the whole, will be found best when delicate colours and fabrics are to be dealt with. There is one advantage of the dry process, which is by no means a small one; that is, there is no necessity to remove any trimmings, such as ribbons, laces, ornamental silk work from dresses or garments, and when there is much of such fancy work about a dress it is best to clean it with the dry process. Generally when a garment has to be dyed afterwards the soap process will be found to give the best results.

#### THE DRY OR FRENCH PROCESS OF CLEANING.

This process is due to M. Judlin, who introduced it in 1866, since which year it has come into very extensive use in all countries. It is the simplest process of cleaning garments which can be used.

**REMOVAL OF GREASE.**—It depends for its success on the fact that the dirt in garments is held there by the grease of various kinds which is sure to collect during the wearing of clothes; so that if you can remove this grease then the dirt will fall out. To remove the grease various solvents are used, such as benzol, turpentine, petroleum benzine, shale naphtha, &c. Besides these there are other solvents, ether, chloroform, bisulphide of carbon; but these are not used on account of the cost of some of them and the offensive colour of the last named.

**Turpentine.**—Turpentine is chemically a compound of carbon and hydrogen, a hydrocarbon having the formula  $C_{10}H_{18}$ . It is a natural constituent of the resinous matter which exudes from various species of pine trees, and it is obtained from it by a process of steam distillation; the more volatile turpentine distils over and is collected, while the non-volatile rosin remains behind. Originally the product was called "spirit" or "oil of" turpentine, the resinous material itself being known as turpentine; but in the process of time the terms oil or spirit of turpentine have become disused and the name turpentine has become applied to the volatile liquid so much in demand by painters. Two varieties of turpentine come into the English market,

American and Russian ; it is also made largely in France, but French turpentine is used almost exclusively in France itself, very little, if any, finding its way into this country. There are some small differences between American and Russian turpentine, but as these have a bearing relating more exclusively to their chemical constitution and structure, it is not necessary that they should be discussed in this work. They have very similar properties, Russian turpentine having rather more odour than American turpentine, and it seems to have a tendency to affect the workman to a greater extent than American turpentine. Turpentine is a clear, water-white fluid, lighter than water, having at 60° F. a specific gravity of 0·865 to 0·867. It possesses a peculiar and very characteristic odour and taste. On exposure to the air it is almost entirely volatilised, there being usually only a small trace of solid matter left behind of a resinous character. Turpentine boils at about 156° C., and is completely distilled at a temperature of 170° C.; old samples may, however, leave a very small residue behind them.

Turpentine is readily combustible ; it flashes at 36° to 38° C. (97° to 100° F.), and at slightly higher temperatures burns with a luminous flame accompanied with the emission of much smoke.

Turpentine is not a good solvent to use with the dry process, as it is apt to leave behind a somewhat unpleasant odour and feel; this is more likely to be experienced with Russian turpentine than with American turpentine, and when the garments are dried slowly, it is rarely used for this purpose, although frequently recommended for taking oil and paint stains out of clothes.

**Benzol or Benzene.**—This liquid is the lightest product obtained during the distillation of coal tar, and it is made in large quantities. It is a hydrocarbon body, and has the chemical formula  $C_6H_6$ ; it is much lighter than water, having a specific gravity of 0·850, and boils at 80° C. (172° F.) It is a water-white, limpid liquid, having a peculiar but not unpleasant odour; it is very volatile, readily passing away in vapour when exposed to the atmosphere without leaving any residue behind. It is very inflammable, burning readily with a luminous and somewhat smoky flame. It is a powerful solvent for all oils and fats, and to its use the dry process owes much of its reputation. It is, perhaps, the best solvent to use for this purpose. It is cheap, can be easily handled, and rapidly clears away all traces of grease from the clothes. It has the advantage over turpentine of being readily recovered from old, used, and dirty material in a serviceable condition, while it dries out of the goods with great ease, and without leaving any smell or residue behind. It may

be mentioned that benzol has no effect whatever on the most delicate colours or tints of dyed goods.

The variety known in commerce as "90's" benzol is the best to use for dry cleaning; it is not necessary that pure benzol be used. The variety known as "50/90's" is scarcely volatile enough for this purpose. It may be explained that these trade terms indicate the quantity of each variety which will distil over at a temperature of 100° C. (212° F.).

It is not often that benzol is adulterated, but the only body which could be conveniently used for this purpose is petroleum benzine, the addition of which may be detected by taking a small quantity and adding a little iodine to it. If there be any petroleum benzine in it the solution will have a strong red colour, while if the product is pure, the solution will be of a violet-red colour.

Another method of testing for petroleum benzine in benzol depends upon the fact that, when benzol is acted upon by a mixture of nitric and sulphuric acids, it is converted into nitro-benzol, while petroleum benzine is unacted upon. To carry out this test 2 ozs. of concentrated sulphuric acid are mixed with 1 oz. of strong nitric acid, in a glass beaker, placed in a vessel of cold water. To the acid mixture is added, with constant stirring, 1 oz. of the benzol to be tested; after being mixed and the action has apparently ceased, the mixture is heated for a few minutes to 60° C. (140° F.), and then poured into cold water; if there be any petroleum benzine in the sample of benzol it will collect on the surface of the water, while the nitro-benzol which is formed will sink to the bottom. The petroleum benzine may be collected and the amount of adulteration approximately ascertained by weighing it. A small proportion of the petroleum benzine will, however, be found in the nitro-benzol which collects at the bottom of the water. This may be separated by a process of distillation from any portions of petroleum products which may yet adhere to it.

Benzol has not the slightest action on the most delicate of tints and colours.

**Benzoline, Petroleum Benzine.**—This product is the second lightest product obtained during the refining of American petroleum, it is also known as petroleum spirit. It is a light, volatile liquid, having a specific gravity of 0·730 to 0·760. It is a water-white, limpid liquid, with the peculiar and characteristic odour of petroleum. It is highly inflammable, taking fire when a light is brought in contact with it; therefore, it requires handling with great care. As a solvent for oils and greases it is not

excelled, hence it has been in use for cleaning garments for many years.

Petroleum benzine is distinguished from turpentine by its more ready inflammability, its lower specific gravity, and by its lower boiling point, which, moreover, is not a stationary one (as is that of turpentine, or of pure benzol), but one that is continually rising; thus a sample may begin to boil at 65° C. (150° F.), and yet not all be distilled over when the temperature has reached 120° C. (250° F.) For the purposes of the garment cleaner a product boiling between 65° C. and 110° C. is the best. Petroleum benzine is not acted upon in the cold by either acids or alkalies, features which distinguish it from either benzol or turpentine.

**Shale naphtha** is a product obtained by distilling Scotch shale, having almost identical properties with petroleum benzine; it has, generally, a slightly higher specific gravity, higher boiling points, and is not so volatile as the petroleum product; it can be used for cleaning garments.

Other bodies, such as carbon bisulphide, ether, chloroform, carbon tetrachloride have the property of dissolving grease and oil with the same facility as those already described, but there are some objections to their use; either they are too costly or they possess an unpleasant odour, or there is some practical objection to their use for this particular purpose. If carbon tetrachloride could be got cheap enough, it would make an ideal solvent for this particular purpose; it is volatile, boils at a low temperature, is free from any unpleasant odour, is an excellent solvent for oils and greases, and is uninflammable.

**THE CLEANING PROCESS.**—There are several ways and different kinds of apparatus which may be used in carrying out the actual cleaning operation in the French or dry cleaning process.

The first proceeding in any case is to sort the goods which are to be cleaned; a very good assortment is into :—

*First.* White woollens, white silks, cream coloured goods, light blue, and light shades in general.

*Second.* Dark coloured goods, browns, olives, clarets, &c.

*Third.* Light shade velvets and plush goods.

*Fourth.* Dark shade velvets and plush goods.

*Fifth.* Black garments.

It is always advisable to keep velvet, plush, and other goods with a pile surface separate from other kinds of materials.

All the garments, &c., should be looked over and well brushed or shaken to free them from all dirt which it is possible to

remove by hand, as it is not advisable to put any more dirt into the cleaning apparatus than can be avoided, as, by so doing, the benzine or solvent can do more work without requiring renewal, and there is less risk of any matter getting fixed on the goods.

**With Mugs.**—The simplest plan which may be adopted in small dyehouses is to provide a number of deep earthenware mugs (four or five), or metallic vessels may be used; each of which should be fitted with a tight fitting lid. These mugs are filled about half full with benzoline; the goods are entered into the first one, left for about a quarter of an hour for the benzoline to soak well into them; after this they are taken out, well squeezed free from any surplus benzoline, and thoroughly shaken. They are next placed in the second vessel in clean benzoline, and again allowed to stay about a quarter of an hour; in the meantime, No. 1 vessel is being filled with more goods. When No. 2 is ready, the goods are taken out, wrung as before, and entered into a third one with fresh benzoline, after which they are wrung, well shaken in the air, and then well brushed. Generally the goods will now be free from any grease and dirt stains, but should any remain their complete removal may be effected by placing the goods in fresh benzoline.

In the same way the fresh goods in No 1 are gradually transferred from one vessel to the other until they are quite clean. In time the benzoline in the first vessel will become too dirty to be of further use; it is now poured into a storage tank to be kept for treatment with a view to recover the benzoline in a useable form by a process which will be described later on. The second vessel is now made into No. 1, while the original No. 1 is filled with clean benzoline and converted into the last of the series. In the same way, when the new No. 1 gets too dirty and full of grease the benzoline it contains is put away to be recovered, and it in its turn is made to be the last one. Working in the manner here indicated, the results obtained are far better than if the goods were simply cleaned in one lot of spirit, while there is an economy in the use of the benzoline.

The method of dry cleaning described above is only suitable for a cleaner in a small way of business. Where there is a large quantity of garments to be cleaned it is advisable, indeed necessary, to adopt some mechanical means of treating the garments. Such machines may be driven by hand or power.

**With Hand-Power Machines.**—A hand-power cleaning machine is shown in Fig. 7, it shows the method of construction fairly well. It consists of a skeleton drum made of wooden rods fastened to two solid wooden discs. A portion of the rods

is, however, made to act as a door for the purpose of introducing the garments into this cage. The cage is placed in a semicircular trough of wood lined with zinc, which contains or holds the benzoline. The whole arrangement is covered with a lid, which is made to fit as tight as possible so as to avoid too much loss of benzoline by evaporation. A handle connected with the internal cage serves to revolve the latter, and so the garments contained therein are well shaken in the benzoline and generally most of the dirt is loosened and, falling through the bars of the cage, collects at the bottom of the outer casing, the greasy matter from the clothes passing into solution in the benzoline. The working of the garments in this apparatus is continued for from half to three-quarters of an hour, when they

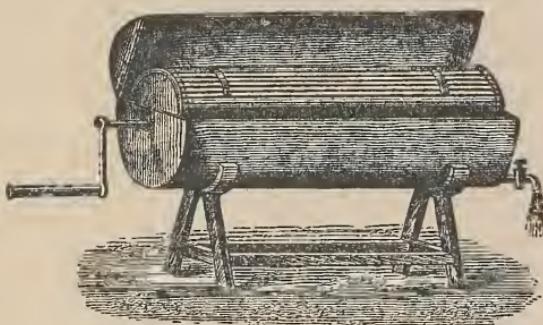


Fig. 7.—Garment clearing apparatus.

are taken out and transferred to a second machine of a similar kind containing cleaner benzoline than that in the first machine; with light coloured and white goods it is often desirable to give them a third treatment in fresh benzoline. When the benzoline in the first machine gets too dirty and full of grease to do its work properly, it is run off into the storage tank, and the machine filled with clean benzoline, when it may be used for the last treatment of another batch of garments, the second machine in its turn becoming the first into which another lot of garments is entered.

As on lifting the garments from this machine a large proportion of the benzoline will adhere to it, it is desirable to allow them to drain as much as possible, or, what is better, placing the garments into an hydro-extractor or centrifugal machine, which is so constructed that all working parts are enclosed, so that no loss of benzoline by evaporation can occur; while the

benzoline which drains out of the machine is collected in bottles or other vessels placed under the outflow pipe for that purpose.

**Power-driven Machines.**—In large garment cleaning works the hand-driven machine described above is replaced by a power-driven machine of which one form is shown in Fig. 8. This machine measures  $4\frac{1}{2}$  feet long by 3 feet in diameter. The mechanism is so arranged as to give an oscillatory motion to the inner cylinder. In some other forms of power-driven washing machines the inner cylinder is made to revolve entirely. These

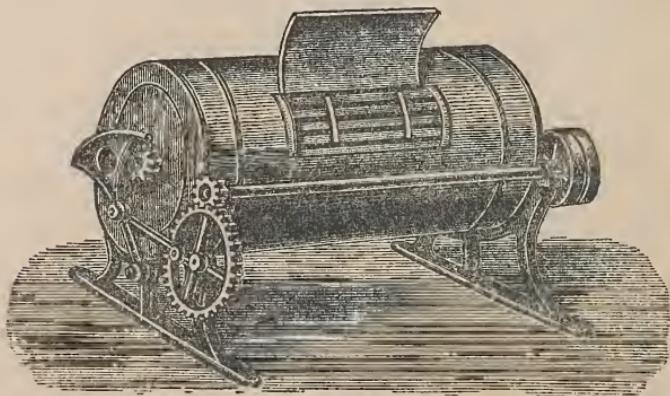


Fig. 8.—Garment cleaning machine.

power-driven machines are worked in exactly the same manner as the hand-driven machines.

In Fig. 9 is shown a pair of benzoline garment cleaning machines as made by Messrs. David Gorrie & Sons, of Perth. The machines are shown open and ready for charging, and the drawing shows well the construction of the inner cylinder in which the goods to be cleaned are placed. The gearing is specially arranged for the purpose of giving the revolving inner cylinder an oscillatory motion.

Another form of cleaning machine, much favoured by some cleaners for treating gloves, furs, and silks, is that known as the Tumbler cleaning machine. It is a long cylinder, the ends of which are closed, while in the centre there is a manhole fitted with a tight cover for the purpose of introducing the articles to be cleaned. This cylinder is hung on a pair of bearings, and by means of suitable gearing it is given an up and down motion, which tumbles the goods and solvent from one end to the other and shakes all the dirt out of them,

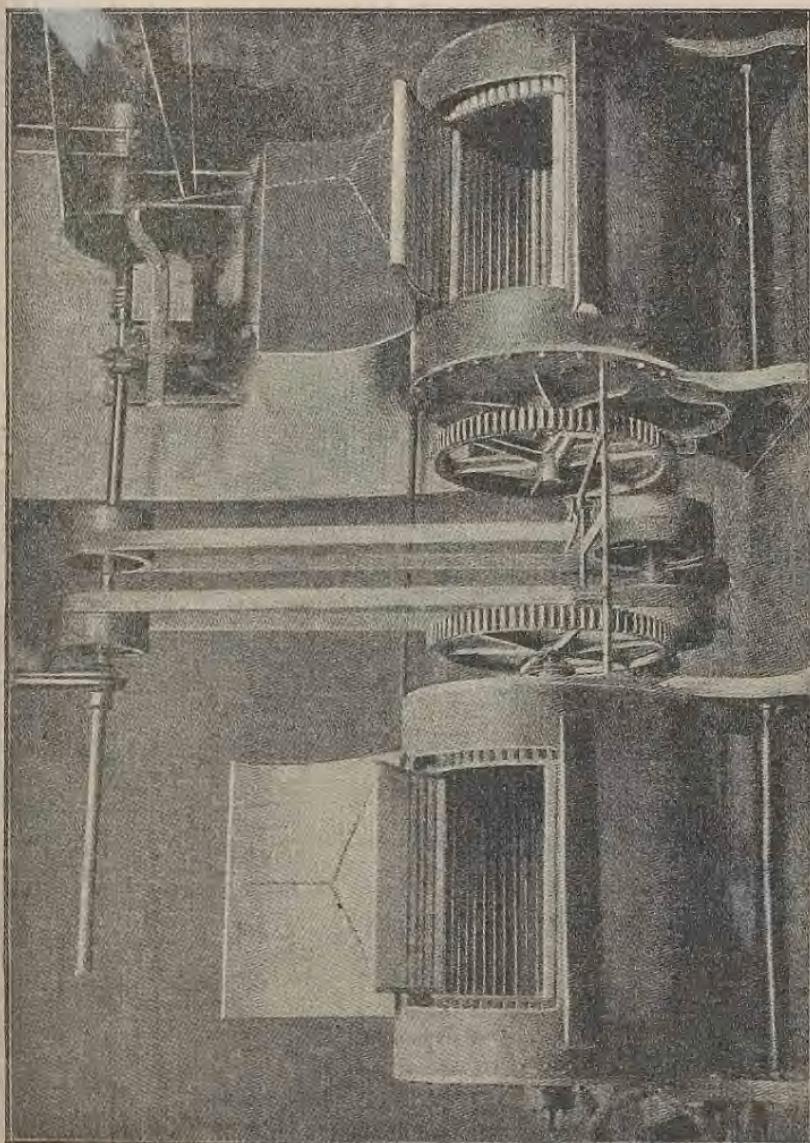


Fig. 9.—Benzoline garment cleaning machines.

After passing through one or other of these cleaning machines, the goods are sent into a hydro-extractor fitted with a hood for the purpose of separating as much of the benzine from them as possible ; then they are put into a dusting drum or dash wheel. This machine consists of a pair of large wooden discs mounted on a shaft ; between the discs and round their circumference perforated zinc or iron wire gauze is fixed, thus forming a drum, into which the cleaned goods are put. On rotating the drum the dirt is thrown out of the goods through the perforations on the outside of the drum, and so away. Usually the drum is fitted inside a chamber, and a fan is so arranged as to draw the dirt into this chamber and away into a flue. In some cases the dash wheel is made with open perforated sides, while the circumference is made solid of wood.

Washing machines, such as described above, are generally only used in the treatment of woollen and cotton garments and articles. Silk fabrics are usually treated by hand, in order to reduce any risk of damage which might occur if they were treated in a machine.

Although much, if not all, of the grease and dirt attached to garments and fabrics are removed by this dry cleaning process, it will not in all cases completely clean and renovate such articles ; sometimes these are stained with paint, acid, fruit, and other stains which are not affected or removed by the benzoline. It, therefore, becomes necessary, after the garments, &c., have been removed from the machines and cleansing apparatus, to examine them to see whether they are stained or not. Such stains are removed by special means, which will be found described further on.

**Purification of Benzoline.**—The benzoline or other solvent which has been used in cleaning garments will be dirty, and contain dissolved in it a quantity of grease and oil. By various purifying processes this benzoline may be treated so that it can be used over again. The best method of treating the dirty spirit is by distilling (as will be described below), but there are other methods which may be adopted to give a small degree of purification, so that the spirit may be used again and again until it becomes too much charged with impurities ; further purification must then be effected by distillation. Some of these simple purification processes will now be described.

**Filtering Process.**—Drevet's apparatus for the purification of benzoline or other spirits is shown in Fig. 10. This is of simple construction. It is a cylindrical vessel divided into three compartments by two divisions, one of which extends from the top

of the vessel to near the bottom, while the other extends from the bottom to near the top, as shown. The middle compartment is filled with cotton wool or some other filtering material. The dirty spirit is placed in the end compartment, and, by virtue of the action of gravity, it flows up through the filtering medium in the central compartment, all dirt and solid particles being thereby removed, while the clean benzoline runs into the last compartment and can be drawn off by the tap as required. The tap is for running away the dirt, which will settle to the bottom of the first compartment. The lid is so constructed as to fit into a water seal so that evaporation is reduced to a minimum. Such apparatus only removes the solid dirt which may be in the spirit; it does not and cannot remove the grease or oil which the spirit holds in solution; nevertheless, spirit cleaned by the apparatus may be used for the first bath in cleansing other lots of garments.

*Soda Process.*—A partial purification of dirty spirit may be effected by placing it in a closed vessel and thoroughly agitating it for an hour with a solution of caustic soda about 4° Twaddell strong. From one-fourth to one-half the volume of spirit of such alkaline solution may be used. The two liquors are thoroughly mixed together and then allowed to stand until the aqueous solution has thoroughly settled out. The weak alkali will act upon the fatty matters present in solution in the spirit, forming more or less soap with them, which will pass into solution in the aqueous liquor and settle out along with it; and the spirit will be purified accordingly and may be used again. Still even this process fails to completely remove all the fat present.

It may be remarked that it is futile to attempt to purify used benzoline or other spirits by treatment with acids, as such bodies have practically no action on the impurities present in such spirits.

Fig. 11 shows Messrs. Gorrie & Sons' new apparatus for cleaning dirty benzoline. The dirty liquor is put into one of the topmost tanks, in which, by a steam pipe, it may be heated

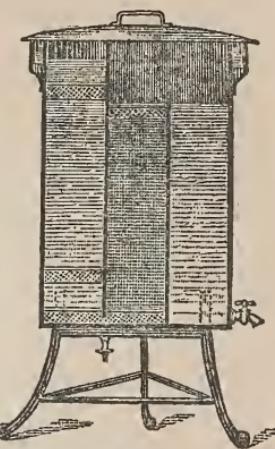


Fig. 10.—Benzine cleaning apparatus.

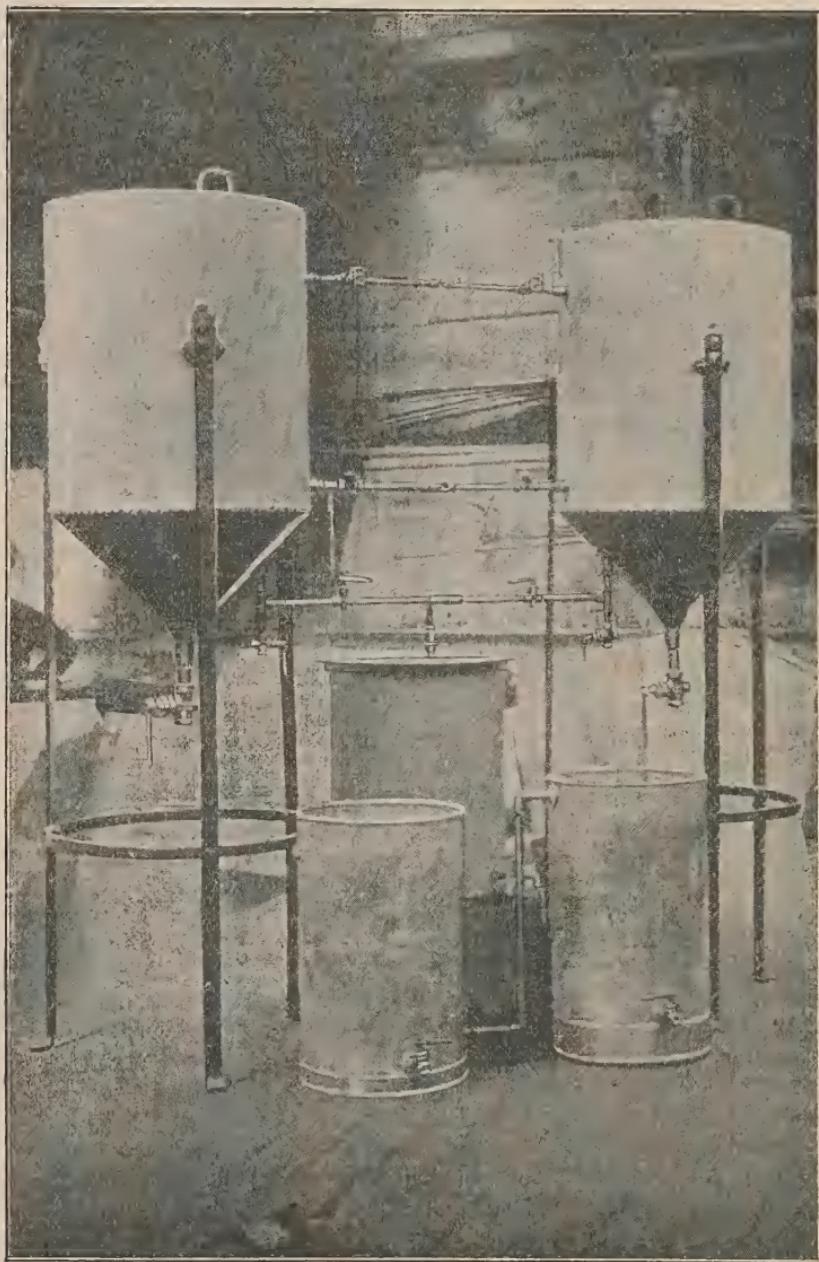


Fig. 11.—Apparatus for cleaning dirty benzoline.

up to 87° or 88° F.; and here it is allowed to rest for a short time, when much dirt settles out; the very dirty liquor is run through the small cocks on the pipe running from the conical end of these tanks into the dirty liquor tank, from whence it is best sent into the distilling apparatus. These cocks are then shut and the side cocks are opened, when the liquid runs into cooling worms placed in the tank at the back of the plant, then into tanks in the front which contain salt, which takes up the water from the benzoline; from these salt tanks it flows into the storage tanks ready for use again.

*Steam Distillation Process.*—The best method of purifying used benzoline or benzine is by distillation by means of steam. One of the most convenient forms of apparatus by which this

can be done is shown in Fig. 12. This consists of an egg-shaped copper vessel supported on three legs. At the lower end is a large tap to allow the residue of the process to be run away. From the upper end proceeds a goose neck connecting by means of a tap with the worm of a condensing apparatus. At one side of the still is a gauge glass so that the quantity of liquid in the still may be observed. A steam pipe connected with a steam coil inside the still sup-

plies the necessary heat. There is also a manhole for cleansing out the still from time to time, and a pipe for charging the still with the benzoline. This apparatus is used in the following manner:—The still is charged with benzoline, and then steam at from 10 to 20 lbs. pressure is sent through the coil; this heats the benzoline above its boiling point, and so causes some of it to vapourise; this vapour, passing over through the gooseneck into the condenser worm, becomes condensed back again into a liquid ready for use for garment cleaning. The condenser is kept cool by a current of cold water which is kept running through it. When all the benzoline has distilled off, the tap at the bottom of the still is opened, and the residual grease, dirt, and oil which is left behind is run away. It will not be necessary to empty the still of the residual matter every time it is filled up, but only at intervals. In fact a continuous system

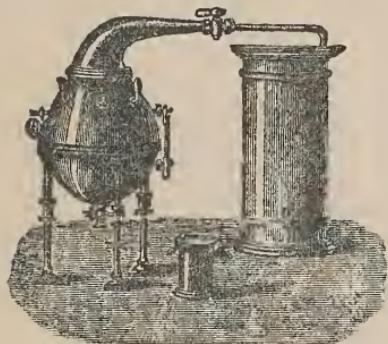


Fig. 12.—Benzine distilling apparatus.

of purification may be adopted. The dirty benzoline may be allowed to accumulate until a large quantity has been collected, when it may be purified, a constant current of impure benzoline being allowed to run into the still as fast as the product distils over. In this way comparatively little attention is required during the progress of the operation, and at the end the residual grease and dirt is run off, the still cleaned out ready for the next lot, while a supply of purified benzoline is obtained for cleaning purposes.

This distilling apparatus may be obtained in various sizes, capable of holding from 15 to 60 gallons.

Another form of apparatus, which is more automatic in its action than the last, is shown in Fig. 13. The dirty spirit is

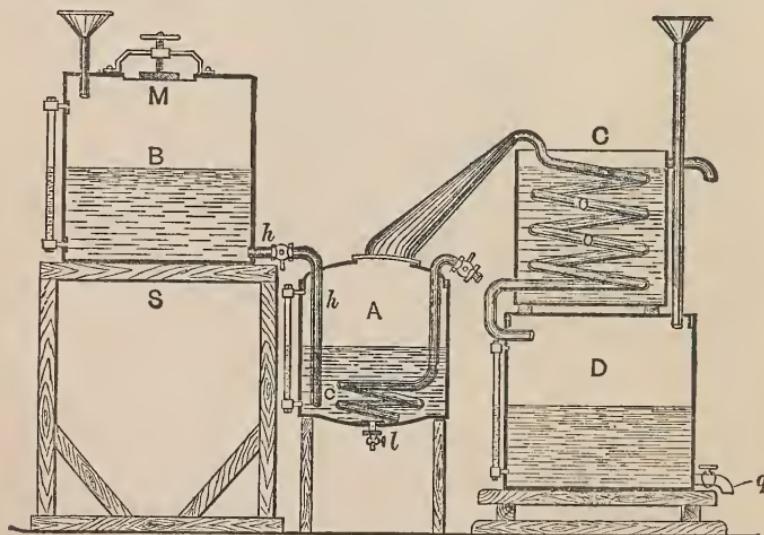


Fig. 13.—Benzine distilling apparatus.

placed in the tank, B, which is supported on the stand, S; this tank can be closed by the manhole, M, which also serves for the purpose of cleaning out and emptying the vessel of any dirt which may settle to the bottom. A funnel, which may pass to the bottom of the tank, serves to fill it with dirty spirit, while a gauge glass at the side shows the level of the spirit in the tank. From the side of the tank, a short distance above the bottom, proceeds a tube, h, h, passing to the bottom of the still, A. The still, A, consists of a boiler-shaped vessel with convex ends. At

the bottom is a tap valve, *l*, for the purpose of emptying it from any residual oil and dirt which is left behind during the distillation. At one side is a gauge glass, which shows the height of the liquid contained in the still. A steam pipe conveys steam through a closed steam coil, *c*, at the bottom of the still. A gooseneck pipe, *o*, from the top of the still, conveys the vapour of the spirit to the worm, *a*, *o*, of the condenser, C; this worm is kept cool by a stream of cold water, which passes through C; the vapour is thereby cooled and condensed into a liquid, which flows into the storage tank, D, placed below; from this tank a supply of purified spirit can be drawn off as required through the tap, *q*. A glass gauge at the side of this tank shows the quantity of liquid it contains at any particular time.

Fig. 14 is the form of benzine distilling apparatus made by Messrs. Gorrie & Sons, of Perth.

The rate at which the spirit can be distilled or purified mainly depends on the quality of the spirit which is being treated, the size of the distilling apparatus, and the pressure of steam used, so that no definite figures can be given here.

After having been cleaned with spirits, the goods are hung in an airy room to free them from all traces of odour.

When working with such inflammable liquids as benzol, &c., every care should be taken to prevent the liquids themselves or their vapours from coming into contact with a light; if this be not done disastrous results may occur. It ought to be a rigid rule that no lights be allowed in the rooms or sheds in which dry cleaning is being done. Such rooms or sheds should be very open, airy, and well ventilated, so that any vapour which may be produced is rapidly mingled with the atmosphere and carried off, and the risk of fire is reduced to a minimum.

#### ORDINARY OR WET CLEANING PROCESS.

This is by far the oldest process for the cleaning of garments and textile fabrics of all kinds. In this process advantage is taken of the well-known cleansing powers of soap, and to some extent the process is simply an extension of the ordinary washing process of the housewife. While there is practically only one method of carrying out the dry cleaning process, due to the fact that the material used has no action whatever on any of the textile fibres, the wet method must be modified to some extent according to the fibre or fibres from which the garment or fabric has been made; a process which works well with cotton might lead to bad results with either wool or silk. Then again

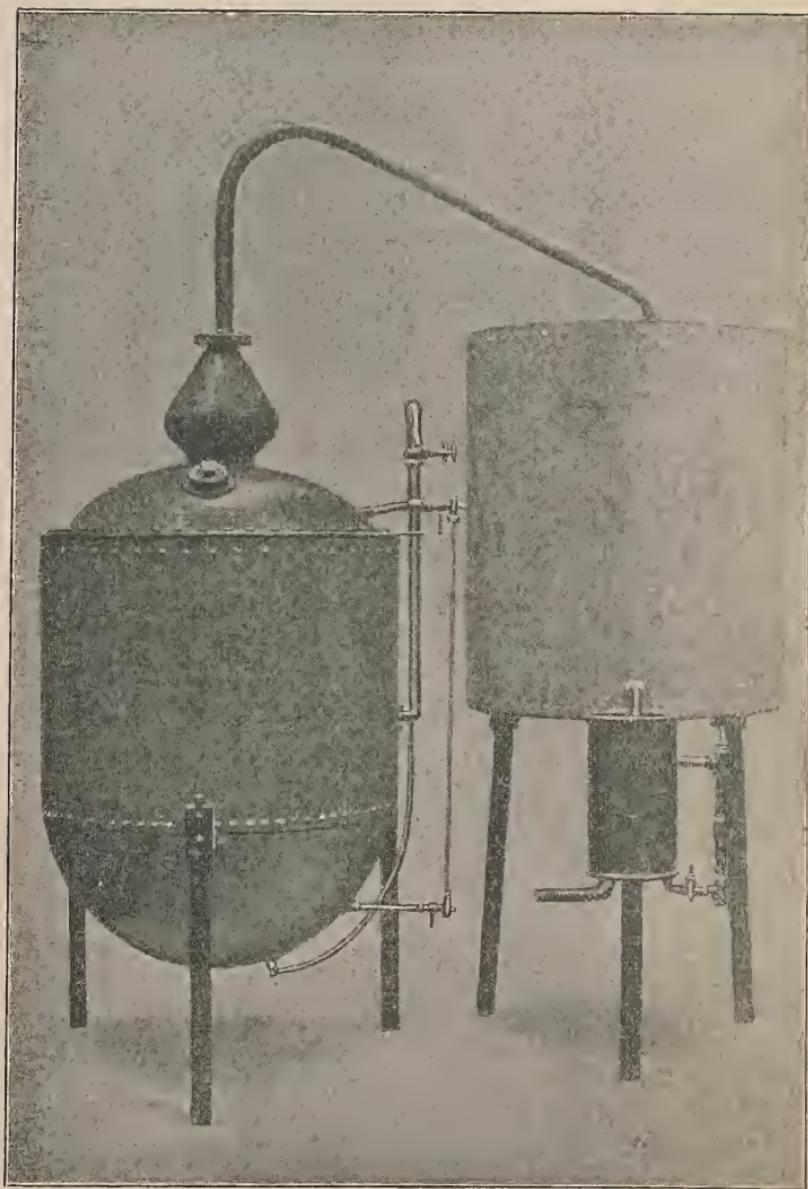


Fig. 14.—Benzine distilling apparatus.

the spirits used in the dry process have practically no action on the colours with which garments, &c., are dyed; but that is not so with the cleansing materials used in the wet process; these may, and often do, have some effect, and the cleaner has to be constantly on the watch to see that nothing detrimental to the character of the colours of the goods he is cleaning shall occur. Then, again, cleansing is always a preliminary operation to dyeing; it is obvious, then, that garments, &c., which are to be dyed in light colours will require more careful cleansing than garments which are to be dyed in dark shades.

**CLEANING SILK GOODS.**—Silk fabrics are comparatively easily cleaned; they, however, on account of their fragility in many cases and the valuable character of the goods in all, require to be very carefully handled. Before being subjected to the cleansing process a careful examination should be made to ascertain the presence or absence of stains of any kind, which, when present, must be removed by some suitable process. (See p. 46, *et seq.*)

A pan of soap, allowing from 1 to  $1\frac{1}{2}$  ozs. of soap to a dress, or 1 lb. weight of silk, with sufficient water to admit of the fabric being handled easily, is prepared. Into this the silk fabric is entered, and by working between the hands is thoroughly impregnated with the soap liquor. The pan is now heated by any convenient means to the boiling point and maintained at this heat for half an hour; at intervals during this operation the material or fabric is lifted out and any dirty places rubbed between the hands to facilitate the removal of the dirt. Usually half an hour's boil will be sufficient to cleanse the fabric, but the cleaner must be prepared to allow a longer time if necessary. When the cleansing has been done, the fabric is removed from the soap pan, well rinsed, first in warm water and then in cool water, after which they are dried in any convenient manner.

Should the colours of any dried silks be dulled by this soaping they may be revived by preparing a weak solution of sulphuric acid (1 oz. in a gallon of water), dipping the silks in this and drying. Acetic acid may be used in place of sulphuric acid, 2 ozs. being added to 1 gallon of water to make the dipping bath.

One fault of this process is that it removes some colours from dyed silks; light blues are especially liable to this decolorisation, as are also pinks and yellows. Where the goods have to be re-dyed, this removal of the colour is not objectionable and is indeed desirable; but where it is desired to retain the original colour, then the soap method of cleansing cannot be followed and recourse must be had to the dry method. No

general rules can be given here as to what colours will, or will not, stand the action of the boiling soap, because the same shade is now obtained from dyestuffs varying greatly in their properties. The cleaner before subjecting any article to the soaping process, the colour of which he desires to retain, should try the effect of soap on a corner of the material ; the result will enable him to decide upon the most suitable process to be adopted.

**CLEANING WOOLLEN FABRICS.—Ladies Dresses.**—These are first sorted according to their colour and dirtiness ; light, clean dresses form the first class ; then those of a medium shade of colour and not over dirty ; lastly, dark and dirty dresses. They are all carefully looked over and any loose dirt brushed off them, the rule being in all cases to keep as much dirt out of the liquors in which the dresses are being treated as possible.

A soap liquor is made from a good soap of say about  $\frac{1}{2}$  lb. to the gallon of water. This may be kept as a stock liquor from which the actual soap liquors used in cleaning are made. A cleaning tub is provided, and this is half filled with clean water and an equal quantity of the soap liquor added. This is now heated to a hand heat, the dresses are entered one by one and rubbed, especially the dirtiest parts, between the hands; after leaving to steep for a short time, during which other dresses are being treated in the same way, the dresses are again rubbed between the hands, then wrung out and placed on one side. The whole batch of dresses is treated in the same way. The soap liquor in the tub is then thrown away and a fresh tubful prepared; this need not contain so much soap as the last, say about three-fourths the quantity; in this the dresses are again treated in the same manner. Finally, they are first rinsed in clean water, then passed through a tub containing a gill of acetic acid to 10 gallons of water ; the acid serves to fix the colours on the wool, and to check their tendency to run. If any dresses are so dirty that the above treatment is not sufficient to clean them, then it must be repeated until they are clean.

A great many colours are so loose that soaping causes them to "bleed" or "run." If there be any suspicion that the colour of any particular dress will run on being soaped, it is a good plan to try a corner first with soap ; should the colour run, dip the corner in weak acetic acid to fix the colour ; then place the dress on one side for treatment by the dry process. As in the case of silk goods it is quite impossible to lay down any general rules whereby a fast colour may be distinguished from a loose colour by inspection ; practice and experience will, however, give

a cleaner a range of knowledge of colours which will stand him in good stead in his business, whereby he will know whether a particular dress had better be treated by the soap or by the dry process. Working the process at as low a temperature as possible has a material influence in preventing the colours from bleeding.

**Gentlemen's Clothes.**—As a rule, the cleaning of gentlemen's garments is plain, straightforward work and very efficiently done by the dry process. When the soap process is adopted, they should first be carefully looked over, and any stains of grease, &c., removed ; then, after turning out the pockets, they ought to be well brushed. A tub of warm soap liquor, to which a little ammonia is added, is next provided, and in this the garments are dipped and rubbed between the hands ; after which they are wrung, placed on a table and brushed with the soap liquor ; next they are placed in a clean tub of soap water, working the soap well in, rinsed in warm water, wrung out, passed through a weak bath of acetic acid which serves to brighten up and fix the colours, and dried.

The great trouble in cleaning all woollen garments and fabrics by the soap process is that of the shrinkage which nearly always occurs and which is rather difficult to avoid. The precautions to be taken consist in not using water that is too hot, which is the most common cause of shrinkage in woollen goods. Then the goods should not be handled too much, and when handled the cleaner should aim at stretching the fabrics. The drying should be done as quickly as possible and on stretchers so as to avoid or prevent shrinking.

**Soap and Water in Garment Cleaning.**—Two very important points in the soap process of cleaning are the quality of the soap and of the water which is used.

The soap used should be of the best quality, made from olive oil, ground-nut oil, cocoa-nut oil, or tallow. These fats all yield a white soap, which can, therefore, have no effect on the colours of any fabrics cleaned with them. The soap should be well made, free from any excess of alkali. This point has an important bearing on the running of the colours and on altering the shade of dyed fabrics. Soaps which contain an undue proportion of free alkali have a strong action on many colours, changing their tint to an appreciable extent, while such soaps invariably are more liable to cause bleeding than a perfectly neutral soap. To test whether a soap is neutral or contains a considerable excess of alkali, a little should be dissolved in water and a drop of a solution of phenolphthalein added ; this should not produce more

than a faint pink coloration. The quantity of free alkali in a soap may be ascertained by taking 10 grammes, dissolving in water, adding a few drops of phenolphthalein solution, and then, from a burette, adding a standard solution of sulphuric acid (which may be bought ready prepared from most dealers in chemical apparatus) until the red colour is discharged. A good soap will not take more than 1 cubic centimetre of the acid solution to neutralise its free alkali, and if it take more it ought not to be used in garment cleaning. The soaps, too, ought to be fairly easily soluble in water, and on this account the soaps made from olive oil, ground-nut oil, and cocoa-nut oil (especially the latter), are preferable to a tallow soap. The cocoa-nut oil soap is much more freely soluble in water than any other soap, and has the merit of being capable of use with greater freedom with hard waters than any other soap; it has, however, the demerit of a tendency to impart a peculiar and unpleasant odour to clothes, which to some persons is objectionable. This solubility of soaps enables them to be used with cold or only luke-warm waters, hot soap liquors have a much stronger action on the colours of dyed fabrics than have cold liquors, and the use of any kind of soaps which necessitates the use of hot liquors is, therefore, to be deprecated. Potash soaps are much more freely soluble in water than are soda soaps, and leave wool and silk more lustrous and soft; but in commerce it is difficult to obtain neutral potash soaps made from fats which give white or nearly white soaps; all the potash soft soaps obtainable are brown in colour (being made from linseed oil or fish oil) and too alkaline for garment cleaning.

The water used in garment cleaning has some influence in the ease and efficiency with which the process can be carried out. Soft waters are those which are most preferable to use. Hard waters, which owe their hardness to containing the carbonates and sulphates of lime or magnesia, are undesirable. The lime they contain has the property of decomposing the soap which is used, and forming, with the fatty matter of the soap, insoluble lime and magnesia soaps, which are precipitated out of the water in the form of greasy, curdy masses that settle on the garments or fabrics being cleaned, and often impart to them a greasy feel and spotty appearance; while they often interfere with any subsequent dyeing operations, and prevent even shades from being obtained. When a cleaner knows he has got hard water to deal with, it should be softened before use by adding soap liquor in sufficient amount, allowing time for the curdy masses of lime or magnesia soaps to come up to the top, and then

skimming these off. Another plan consists in adding about one-sixteenth of an ounce of sodium phosphate per gallon of water; the lime is precipitated out as insoluble lime phosphates, which settles down to the bottom. The softened water may then be used.

In large cleaning and dyeing establishments where steam power is used, the exhaust steam, and the waste steam which has been used to heat the various dyepans, may be condensed and used for making the various soap liquors and dye liquors which are required. Much soap may be saved by using such condensed waters, while all the cleaning and dyeing operations will be conducted more efficiently.

**CLEANING COTTON GARMENTS, &c.**—Dresses, curtains, &c., made from cotton do not offer much difficulty to the cleaner, partly because, on occasion, he can use stronger and more alkaline liquors, than is possible with wool or silk, without fear that the cotton will be deteriorated in strength; so that the same amount of dirt and stains can be more readily removed from cotton than from wool and silk. The method of cleaning cotton articles is very much that of the plan followed by the laundress in washing clothes, and does not need detailing here. The greatest source of difficulty in cleaning cotton fabrics arises when they are dyed or printed. Sometimes fabrics, which are dyed in self-colours, show a tendency for the colour to bleed. This can only be reduced to a minimum by working at as low a temperature as possible and quickly. It is a good plan, with all brightly coloured cotton fabrics, to treat each separately, and not to mix coloured and white goods together indiscriminately; since, if any colours should run, the white goods are very liable to become stained. Soda is a fruitful cause of colours running, and its use should be avoided, or, at all events, used as little as possible. In the case of printed calicoes, it is desirable that, with a view to prevent the colours from bleeding into the whites, they should be dealt with as quickly as possible and dried off rapidly.

As a rule, cotton does not exhibit much tendency to shrink, and so no particular care is needed in the drying of them to prevent any shrinking; lace curtains and loose fabrics must, however, be dried on stretchers or frames, mainly with a view to keeping them straight.

### REMOVING STAINS.

Garments of various kinds are liable to become stained or spotted in a variety of ways during wear. These stains have to be removed before the garments can be thoroughly cleansed. The methods to be adopted for this purpose will naturally depend upon the character of the stain and also upon the material of which the textile fabric is made. As regards the latter feature, it may be laid down that cotton fabrics or fabrics containing cotton should not be treated with strong acids, as they have a destructive effect upon the fibre; dilute acids even have some action; certain organic acids, such as acetic acid, oxalic acid, and tartaric acid may be used, if an acid is necessary for the removal of stains. Linen and other fabrics made from vegetable fibres should be treated in the same way as cotton. Wool, silk, and all animal fibres should not be treated with strongly alkaline liquors; weak ammonia may be applied, as may also very weak solutions of soda; but it is best when fabrics made of these fibres are to be dealt with never to use any other alkali than ammonia, which has no action on them. Acids of a moderate degree of strength have no effect on the animal fibres.

**Grease Stains.**—Grease stains are about the most common kind of stain to be met with. These are of two kinds—first, stains due to mineral oils unremovable by means of soap; and second, stains due to such fatty bodies as tallow, butter, olive oil, linseed oil, cotton oil, &c., which can be removed by means of soap. It is quite impossible to tell the kind of stains by simple inspection. Perhaps the best plan of dealing with oil stains is to rub them over with a little oleic acid, allow this to soak in, then treat the stains with soap and water, which will, as a rule, be found effective in removing them; a little soda may be added to the soap liquor. Another plan frequently recommended for dealing with oil stains is to place a cloth under the stain, dip a sponge in benzol and damp the stain, wait a few minutes until the liquid gets well soaked in, then place over the wet stain a piece of clean blotting-paper, this absorbs the oil which has been loosened from the cloth by means of the benzol; by repeating the process as often as necessary the stain may be removed. One advantage of this plan of working is, that the colour of the fabric will not be affected, as it might be, with the soaping process.

**Wax Stains, Resin Stains, and Pitch Stains.**—To remove these is often a matter of some difficulty, especially with the latter kind of stains. First, remove as much as possible by

scraping with a knife or other mechanical means, taking care that the fabric be not damaged by this process in any way. Then, in the case of wax and resin stains, treat with benzol as described under grease stains, when, in general, they will be found completely removed. Pitch stains and tar stains are best removed by benzol ; a preliminary treatment of the stains with a little oil much facilitates their removal.

One of the disadvantages attending the use of benzol for removing spots of grease is, that it often leaves a spotty appearance on the fabric. To remedy this defect it has been proposed to use two preparations of benzol, gelatinised benzol, and benzolised magnesia.

*Gelatinised benzol* is made by dissolving 12 ozs. of olive oil soap in 18 ozs. of boiling water and 3 ozs. of liquor ammonia ; then add sufficient water to make  $1\frac{1}{2}$  pint of liquid and 5 ozs. of benzol, and shake the mixture well. One oz. of this mixture is then mixed with 9 ozs. of benzol to form the gelatinised benzol. This product is used for the removal of stains in the same way as benzol.

*Benzolised Magnesia*.—Calcined magnesia is mixed with sufficient benzol to make a pasty mass. It is spread somewhat thickly over the stain and well rubbed in, then brushed off and a fresh supply rubbed in ; this operation being repeated until the stain is completely removed. Any adherent particles of magnesia are easily removed from the fabric by brushing.

Paint stains are often met with on garments and dresses ; their removal is sometimes troublesome, as much depends on their age ; fresh paint stains can be readily removed by the use of turpentine, which is applied in the same way as benzol to grease stains. Old stains are best removed by repeated applications of a mixture of turpentine and chloroform ; the solvent should be allowed to soak well in before the application of the blotting-paper. The use of soda in any form is not admissible, and is not so satisfactory as treatment with turpentine and chloroform.

*Iron Stains*.—These are not very easy to remove, generally they require the aid of an acid. One very good plan is to moisten with acetic acid, allow the acid to soak well in, then wash with water. Oxalic acid may be used in place of acetic acid, a strong solution in water being used. Sometimes rubbing the spot with a piece of tin causes the acid to act more quickly.

A mixture of cream of tartar and citric acid, in equal quantities, is a very good agent for removing iron stains from cloths. The spot is moistened with hot water and the mixture rubbed

in. When the stain is removed the cloth is washed with water and dried.

Acid agents, like those named, cannot always be used on account of their affecting the colour of the dyed fabric; when this is the case some other method must be adopted. A good plan is to make a mixture of glycerine and soft soap, with a little water, rub the spot with this, allow to remain on for some hours, then wash off with water. If one application does not remove it, repeat the process.

Ink stains can, in general, be removed by much the same methods as recommended for iron stains. Much, however, will depend upon the character of the ink which has produced it; most writing inks are made with iron and gall nuts, these can be removed by any of the methods described above. Some writing inks are made with aniline dyes; these may require the application of bleaching agents, such as chloride of lime or bisulphite of soda, or a mixture of bisulphite of soda and zinc. In applying these bodies great care must be taken, especially with the first, not to use them too strong or they will act upon the fabric and destroy it. In another chapter the use of these bleaching agents will be discussed in detail.

Fruit stains may be removed from many fabrics by simply washing in water containing a little borax or liquor ammonia; this simple treatment should be tried first, as it will have no material effect on the colours of any dyed fabrics. White linen and cotton goods may have the stains of fruit removed from them by dipping in a very weak solution of chloride of lime to which a few drops of acetic acid have been added. When the stains have been removed wash the goods in clean water.

Woollen goods cannot be treated with chloride of lime nor can silk fabrics. In such cases where the washing with borax or ammonia fails to remove the stains, they must be treated with a weak solution of sulphurous acid, or bisulphite of soda, washing well after the stains have been removed. First treating with bisulphite of soda, then with a little tartaric acid will often remove fruit stains from wool or silk goods. Such treatment as is here given is only available for white wool or silk fabrics; the colours of dyed fabrics will not resist the action of the sulphurous acid.

Coloured wool and silk fabrics can only be treated with soap and water for the removal of fruit stains, and if this does not remove them then the only course is to re-dye the goods.

Wine stains have much the same properties as fruit stains, and can be removed by the same means.

Coffee and tea stains can also be removed by similar means to those used for removing fruit stains.

Acid stains are easily removed, when fresh and caused by weak acids, by treating the parts with a little liquor ammonia. Old acid stains are much more troublesome; and if ammonia will not restore the colour there is no other remedy but that of re-dyeing the goods. With black dresses and clothes it is possible to dye or paint the spots over with a dye liquor without showing that such has been done. This, however, is scarcely possible with other colours.

Stains which have been produced by strong acids cannot be removed, as the material itself has generally been destroyed.

The following table, compiled from a variety of sources, gives at a glance the methods to be adopted for the removal of stains of all kinds from different kinds of fabrics :—

Kind of Stain.	White Linen and Cotton Goods.	Coloured Cotton Fabrics.	Coloured Woolen Goods.	White Woolen Goods.	Silk Fabrics.
Grease,	Soap and alkaline liquors.	Luke-warm soap liquors.	Soap liquors and ammonia.	Soap liquors and ammonia.	Benzol, ether, ammonia, magnesia.
Paint and Varnish Stains,	Turpentine and chloroform followed by soaping.				
Iron and Gall Ink stains,	Warm oxalic acid liquors or dilute hydrochloric acid.	Treatment with citric acid or dilute hydrochloric acid, if the colours will resist acids. Or treatment with a mixture of glycerine and soft soap.	As white cotton goods.	Same as woollen goods.	
Sugar, Glue, and Blood Stains,	Generally simple washing with warm water is sufficient.				
Fruit and Wine Stains,	Treatment with weak chloride of lime.	Wash with soap liquors and ammonia.	Treat with warm water and bisulphite of soda.	Wash with soap liquor and ammonia.	
Coloured Ink Stains,	The treatment is the same as for fruit stains.				
Acid Stains,	When fresh can be destroyed by ammonia followed by washing. Yellow or brown stains of nitric acid are permanent.				
Tar and Pitch Stains,	Treat with benzol, or first rub with oil, then treat with benzol or turpentine. Washing off with soap.				
Wax Stains,	Scrape off and remove with benzol.				
Wine, Beer and Spirit, and Tea and Coffee Stains,	The treatment is the same as for fruit stains.				



## CHAPTER III.

### 1. DYEING OF TEXTILE FABRICS.

**JOB DYEING**, or the re-dyeing of used textile fabrics, is at once perhaps the most difficult and yet possibly the most interesting branch of the textile colouring arts. The variety of materials, for generally a job dyer will have nearly every kind of textile fibre pass through his hand, and the great variety of the fabrics which have to be dealt with add to the difficulties of the work; but it never gets monotonous, as is the case with those dyers who simply deal with one great department of the art. A job dyer on this account should have a wider knowledge of the art of dyeing than any other class of dyers. At the same time this very variety with which the job dyer is brought into contact with makes it exceedingly difficult for a writer to deal with the subject, for he cannot possibly give instructions which will meet every case which the job dyer may have to deal with. In the present book the author will endeavour to put the matter in such a form that the intelligent workman will be able to apply such general principles as may be laid down to any particular job he may have in hand.

The garments, dresses, fabrics, &c., which the dyer and cleaner will have to treat in the course of his business will be made from a great variety of woven textile fabrics or fibres. Thus he may have goods made from

1. All silk,
2. Part silk, part wool,
3. Part silk, part cotton,
4. All wool,
5. Part wool, part cotton, part silk,
6. Part wool, part cotton,
7. All cotton,
8. All linen,

and possibly also fabrics containing jute, china grass, &c.

The question is further complicated where ladies' dresses, gentlemen's clothes, &c., are made with several kinds of textile fabrics, as, for instance, silk dresses with wool or cotton linings.

wool dresses with cotton linings, dresses of cashmere with silk ribbons and trimmings, and so on. Then another feature which has some influence is the colour already on the garments or fabrics which have to be dyed.

The influence which the colour on a dyed fabric will have on the colour in which it is to be re-dyed is of great importance, and requires attention from dyers. Any fabric can be re-dyed the same colour as it originally was, but the results are not in all cases satisfactory, owing to the presence of soiled or faded parts which will not, in the dyeing process, take quite the same shade as the rest of the fabric; it is best in such cases to re-dye to a darker shade.

*Black* can be dyed over any colour, but the shade or tone of the black will be more or less modified by that of the under colour; thus a black over red will show a reddish or brownish tint which may not always be agreeable; blues and greens when re-dyed black give the best results.

*Amber-dyed goods* can be dyed almost any colour, the only exceptions being lavender, pink, and light blues. Reds are apt to come up of a scarlet hue, while blues tend to a green shade; these troubles may be avoided by using a bluer shade of red or a redder shade of blue than was originally intended.

*Black goods* may be dyed in dark shades, such as browns, clarets, maroons, dark navys, olive, plum, &c. Much, however, depends upon the dyestuffs which were used to dye the original black; if logwood be the basis then treatment with acid will strip the black off the goods without much difficulty. If Aniline black or some of the more modern coal-tar blacks have been used then the black cannot be stripped off sufficiently to admit of re-dyeing any other colour, and the only thing which can be done is to re-dye the goods black.

*Blue-dyed goods*, if in pale tints, can be re-dyed any colour. Dark blues can be re-dyed in dark shades of brown, cardinal, claret, green, olive, &c.

*Brown fabrics* can be re-dyed brown, claret, olive, and dark prune.

*Clarets or maroons* will dye browns or olive.

*Crimson-dyed goods* may be re-dyed brown, claret, dark greens, and dark shades generally.

*Cream-coloured fabrics* can be dyed any colour.

*Green-coloured goods* can, if the shade be light, be re-dyed almost any colour except pale blue, rose, pink, or yellow. Dark shades of green can only be re-dyed dark shades of browns, clarets, maroons, and navys.

*Yellow-coloured fabrics* can be re-dyed almost any colour, except pale blues, pinks, salmon, rose, and similar tints.

*Drab-, fawn-, slate-, and grey-coloured goods* can be re-dyed any colour, with the possible exceptions of pinks, rose, yellows, pale blues, and similar pale tints.

*Lavender colours* may be dyed all colours except pale yellows, ambers, pale pink, and straw.

*Mauve-coloured fabrics* may be re-dyed in dark shades, such as browns, clarets, prunes, maroons, olives, which generally show a tendency to come up a reddish tint.

*Olive-coloured goods* can be re-dyed in dark shades only, like mauve goods.

*Pink-, salmon-, and rose-coloured fabrics* can be re-dyed any colour.

*Scarlet-dyed goods* can be re-dyed any darker shade of red, brown, dark navy, &c.

**TESTING DYED GOODS.**—The garment dyer will find it to be of great service to him in his business to possess a knowledge of how to examine dyed garments, so as to ascertain the nature of the dyestuffs with which they have been dyed; this knowledge might help him very materially by showing him how to destroy it; if it be possible to re-dye the goods without such a proceeding; or what dyestuffs to use in producing the new shade required, having regard to the dyes already on the fabric. Then, again, this knowledge might give him a clue to the mode of treating the garments in a manner that will improve them. The following notes will give a few hints to the garment dyer on this subject, but it must be obvious that, owing to the very large number of dyestuffs at present in use, it is practically impossible to describe all the reactions of these dyestuffs, nor is it possible for a dyer to apply many tests to the garments he has to deal with. In the author's *Silk Dyeing* some additional information, especially as relating to dyed silks will be found, while Knecht & Rawson's *Manual of Dyeing* may be consulted for full information on the subject.

**Reds.**—Dip a corner of the garment in boiling soap liquor. If it bleeds quickly it has probably been dyed with Eosine, Magenta, or Safranine. If the colour goes completely, then Acid Magenta has been used; the colour is, however, restored on placing the fabric in a little weak acid. Cochineal scarlets are turned somewhat duller. The Azo scarlets will bleed a little, but the tone will not be materially affected. Alizarine dyed reds are not altered at all by the soap. The reds from Benzopurpurine and similar direct red dyes are brightened by the

soap liquors. It is obvious that in cleaning garments dyed with red colours which are loose to soap, they must be treated with some care. If the goods have to be re-dyed, those reds which can be removed by soaping offer some advantages, and the goods should be soaped well before re-dyeing. Treat a corner of the garment with a drop of moderately strong hydrochloric acid. Reds dyed with Benzopurpurine, Congo, Diamine red turn blue to blue-black, but the colour comes back on the material being washed in soap. Alizarine reds are not affected. Safranine reds are turned blue. Magenta reds are turned brownish-yellow. Eosin reds are scarcely altered. Some of the Croceines are turned a little bluer in tone. Many of the Azo scarlets are not altered.

**Blues, Bright Tints.**—Dip a corner of the dyed cloth in ammonia; if the colour disappears, and is restored on the addition of acid, the cloth has been dyed with Alkali blue. If the colour is not affected by ammonia, then, probably, indigo extract or Methylene blue have been used; acids will decolorise the latter, but not the former. Blues dyed with the Victoria blues are turned yellow with strong acids. Navy blues are dyed with a variety of dyestuffs, both used alone and mixed together in various ways, which makes it rather difficult for tests to be given. Those dyed with logwood on a chrome bottom are turned red by acids. Nitric acid turns those dyed with indigo yellow, but has no effect on those dyed with Alizarine blues. Those dyed with Naphthol black are turned greenish by nitric acid. Navy blues dyed with cudbear and Alkali blue, or cudbear and indigo, are brightened by treating with sulphuric acid; soaping, however, destroys the colour, which is restored by washing. Navy blues dyed with Alizarine blues, Naphthol black, logwood, indigo, and similar dyes are not affected by treatment with soap and alkalies. Such blues dyed with Alizarine blues, Naphthol black, Acid blacks, cannot well be stripped, and the best course is to re-dye with the same dyestuffs.

**Browns.**—Goods dyed with Bismarck brown, Fast brown, Acid brown, bleed on being soaped; for re-dyeing, such colours may be stripped by either an acid or soap bath, and then the goods are ready for re-dyeing. Anthracene brown is not affected by acids and alkalies and cannot be stripped. Browns dyed with cutch and copperas, or cutch and bichromate of potash, are not affected by a soap bath. Neither are they altered by acids.

**Blacks.**—Logwood blacks are reddened by acids, and may be stripped in an acid bath. Indigo blacks are but little affected by weak sulphuric acid, but form a yellow spot when touched with nitric acid. Many blacks are now dyed with Naphthol,

Acid, Victoria, Alizarine, and Aniline blacks; these are not altered by dilute sulphuric acid, nor are they touched by soap and alkalies. Nitric acid produces spots on those dyed with Naphthol, Acid, and Victoria blacks, but does not, or scarcely, affect those dyed with Alizarine and Aniline black. None of the blacks just named can be stripped from the cloth, and all that can be done is to clean them well and re-dye them black.

**Yellows.**—Acids decolorise Picric acid, Naphthol yellow, and Auramine yellow colours. Chrysamine, Chrysophenine, Titan yellow, are turned more or less brownish by acids. Aurantia yellows, which are found mostly on silks, are turned pale yellow by acids. Alkalies reddens the yellows dyed with Chrysamine, Titan yellow, and some other direct yellows. Fustic yellows are turned orange by acids.

**Greens.**—Greens are produced in so many ways that it is difficult to give satisfactory tests for them. Green colours dyed with some of the basic coal-tar greens, which are usually of bright tints, can be removed by boiling with soap. It has no action on the greens dyed with Alizarine green, fustic and indigo, Naphthol green, Gambine green. Acids turn many of the bright greens from basic dyes brownish yellow; they have scarcely any effect on those dyed with fustic and indigo, Alizarine green, Gambine green, Azo green, and some others.

**White.**—Silk and woollen fabrics which have been bleached with sulphur are rather troublesome and difficult to dye in pale tints, the tendency being for them to show streaks. This effect is largely due to the sulphur they contain; this must be removed before they can be properly dyed. The best way to do this is to scald them in weak ammonia, 1 gill of strong ammonia liquor to 5 gallons of water. Some dyers add a little ammonia to the dye bath, but this course cannot be recommended.

In the *Manual of Dyeing*, vol. ii., by Knecht and Rawson, will be found some valuable Tables showing the reactions of fibres dyed with various dyestuffs.

**STRIPPING COLOURS FROM GARMENTS.**—Before proceeding to re-dye a garment or dress, it is often necessary to remove the old colour as completely as possible, so that it shall not interfere in any way with the production of the new colour; which it might do by interfering with the tone or shade of the new colour. It is not every colour that can be stripped; there are some, such as Alizarine blue, Turkey red, Naphthol, and Aniline blacks, which it is quite impossible to strip, as has already been mentioned.

There are many ways in which a colour can be stripped.

First of all, it is as well to try the effect of a good soap liquor on the colour; some will thereby be stripped; even if the colour does not yield to this operation, then it will be prepared for another process. It may be mentioned here that, if soaping will not remove colour from dyed cotton goods, then no other process is practically available without running a great risk of destroying the fabric, and that must be avoided.

Soda may be used along with the soap, and some colours will, perhaps, yield to soda when soap alone would have no effect, but soda must be used with care; cotton goods will not be much affected, but silk and wool fabrics are liable to be materially altered.

A fairly good process for stripping some of the aniline colours consists in preparing a liquor from 1 lb. of zinc powder and  $2\frac{1}{2}$  ozs. of quicklime, mixed with water; boil up for half an hour, then allow the mixture to settle; the clear liquor is separated from sediment, and mixed with sufficient water to work the goods in comfortably. The proportions given above will usually suffice for 10 lbs. of goods. The goods are allowed to steep in the liquor for six to eight hours, taken out, rinsed, boiled in a fresh bath with 10 ozs. of alum and  $1\frac{1}{2}$  oz. of tartar for half an hour, washed, and dried. Generally this process will be found a good one, and there is not much risk of damaging the goods by it.

Prepare a bath of  $1\frac{1}{4}$  lb. sulphuric acid and 4 ozs. oxalic acid in sufficient water, and allow the goods to steep in this for some time; if the colour be not sufficiently discharged, repeat the operation. This process is only available for wool and silk goods.

Make a bath of  $1\frac{1}{2}$  lb. of bichromate of potash and 4 lbs. sulphuric acid, and boil the goods in it. Some colours, such as browns and blacks, may be often removed by this method.

The most common plan for stripping colours from dyed fabrics (which, however, is applicable only to wool or silk fabrics) is the following:— Prepare a bath by mixing  $\frac{1}{2}$  gallon of nitric acid with 1 gallon of water. In this bath, which is used cold, the goods are dipped and moved about for three or four minutes; after which they are taken out and well rinsed in water. If the colour is not sufficiently discharged, re-dip the goods in the nitric acid. Great care is required in working with nitric acid; if too strong, or the action is too prolonged, the acid has a tendency to turn the fibre yellow, and this yellow colour cannot be removed. Another trouble which may arise is that of tendering of the fibre; this is most likely to happen when the acid is used too strong. It is better to allow the acid to act only for

a few minutes at a time, than to allow the goods to remain in the acid too long. If necessary, the goods are redipped, and washed after each dip.

What is known as hydrosulphite of soda—prepared by taking 1 lb. zinc dust and adding slowly and with constant stirring to a mixture of 10 lbs. of bisulphite of soda and 1 gallon of water; after one-half to three-quarters of an hour the product is ready for use—has a very strong action on colours, so that there are very few dyes which will resist its action. A process for stripping the colour from dyed fabrics may be based on this. It consists in preparing the hydrosulphite liquor as given above, then steeping the goods for some hours, or over night, according to the depth of the colour in which they are dyed. At or towards the end the bath may be heated up slightly to increase the action. One advantage of this process is that there is no action on the fabric; there is no rotting action as in using nitric acid, while there are very few colours that cannot, by prolonged treatment and the aid of heat, be discharged with sodium hydrosulphite.

## 2. DYESTUFFS.

The chemical composition and properties of the many dyes which are available for the use of the dyer are given in full detail in the author's *Dictionary of the Coal-Tar Colours* and in Knecht & Rawson's *Manual of Dyeing*. Here a general outline only will be given of the main properties of the various classes of dyestuffs, with the principles which underlie their application to the various textile fibres. Dyestuffs are obtained from both natural and artificial sources; formerly only the natural ones were available for the use of the dyer, but the researches of modern chemists have placed in the hands of the textile colourist a wide range of artificial dyes which are gradually displacing the natural dyes; in fact, some of the latter have practically become obsolete. The artificial dyes have the advantages of being more easily applied, giving a wider range of colours and shades and of being cheaper. There is really no essential difference in the methods of application of the natural and artificial dyes, so that in this book we can treat them altogether.

On the basis of chemical composition and relationship the dyes may be arranged in some sixteen or seventeen groups, but, practically, from the dyer's point of view, a classification into five groups is sufficient:—

1. Direct dyes.
2. Basic dyes.
3. Acid dyes.
4. Mordant dyes.
5. Indigo dyes.

**1. DIRECT DYES.**—The group comprises numerous artificial dyes of comparatively recent introduction; the first known, Congo red, was only introduced towards the end of the year 1885, yet now they number hundreds and comprise almost every colour the dyer requires, with the possible exceptions of bright violets and greens. Possibly turmeric and safflower, which are natural dyes, might be added to this group.

Cotton does not require any mordant with these dyestuffs. All can be dyed on to cotton by simply boiling in a bath containing common salt to the extent of about 15 to 20 per cent. of the weight of the fabric to be dyed. This method of dyeing is particularly useful with the Titan colours of Messrs. Read Holliday & Sons. The Benzo colours of the Farbenfabriken vorm. Fr. Bayer & Co., the Congo colours of the Actiengesellschaft für Anilin Fabrikation, the Diamine colours of Messrs. Cassella & Co., are on the whole best dyed from a boiling bath which contains about 5 per cent. of soda, 3 per cent. of soap, and 10 per cent. of Glauber's salt; these proportions are calculated on the weight of the cotton. The reds of these classes dye very well this way; some of the yellows and blues give good results, but on the whole they dye best from a bath of 3 per cent. of soap and 10 to 15 per cent. of Glauber's salt; the browns can be dyed either way; the blacks in the same way as the reds.

In no case is the dye bath completely exhausted; it may be kept standing and used over and over again, simply adding about two-thirds of the original quantity of dyestuff and about one-half of the original proportions of the other ingredients and sufficient water to bring up the bath to its original volume.

The goods may be entered into the dye bath at any convenient temperature, but they should be boiled for at least an hour.

The yellows are generally very fast to light and resist washing very well. The reds are fast to washing. The Titan reds are also fast to acids; the others are in general turned more or less blue in colour by acids, and are not fast to light. The blues are moderately fast to light, stand washing and acids very well, but are reddened by alkalies. The browns are not fast to light; they resist soaping very well and are tolerably fast to acids. In the dyeing recipes which will be found below many examples of the use of those dyes will be found.

The blacks are all fairly fast to washing, alkalies, acids, and soaping, and, therefore, will be found very serviceable in garment dyeing.

On wool this class of colours can be dyed from a bath containing 15 per cent. of common salt, or of Glauber's salt with a small trace of acid. The Titan colours will be found to give very good results, the Benzo, Congo, and Diamine reds are dyed best in a neutral bath; the Chrysamine, Chrysophenine, and Clayton yellows can be dyed either in a neutral or an acid bath. Generally the blues will be found to give redder shades on wool than on cotton.

Fabrics made from both wool and cotton, such as those known as half-wools, zanella, merinos, unions, &c., can be dyed with these direct colours best from neutral baths; the reds and yellows will be found to give the best results; the blues tend to dye the wool in a redder tone than the cotton, and are on that account rather unsatisfactory for this class of goods.

Silk can be dyed either from a bath of salt or from a bath containing phosphate of soda; in some cases the addition of a little acetic acid, as with Chrysophenine, the Titan colours, &c., enables the dyestuff to combine more easily with the silk, and so fuller shades are obtained. Generally these direct dyes work on silk very well indeed; the yellows dye good full shades very fast to light and washing; the reds are brilliant and usually fast to washing; the Titan reds are fast to acids; the Benzo reds are turned blue to black by acids, as are also the Diamine reds. The blues generally dye silk a redder tone than they do cotton; generally they are fast to acids, to washing, and fairly so to light. The browns are fast to acids and washing, to light they are faster on silk than on cotton. The blacks work fairly well on to silk giving good shades which are fairly fast to light, acids and washing.

For half-silk fabrics the direct dyes will be found useful; they are best applied from dye baths containing salt, Glauber's salt, or phosphate of soda. The yellows, reds, and browns dye this class of material very well, the cotton and the silk taking the dyestuff with much the same affinity, and, therefore, giving good level shades; the blues do not work so well on half-silk goods in consequence of the silk taking a redder shade.

Further on will be found some recipes showing the application of these direct dyes to the dyeing of various kinds of fabrics.

**2. BASIC DYES.**—They are comparatively few in number, but they comprise some of the oldest coal-tar dyes known, as well as the most brilliant and valuable. Magenta, the Methyl

and Paris violets; Brilliant, Malachite and other greens; Bismarck Brown, Chrysoidine, Auramine, Induline, Nigrosine, Phosphine, Methylene blue, &c., all belong to this class of dye-stuffs. They may be used to dye all kinds of textile fibres.

Cotton requires to be mordanted with tannic acid or some other tannin material, such as sumach, chestnut, divi divi, myrabolams, &c. The colours obtained are full, bright, and fairly fast to washing, but are usually fugitive to light, although there is great differences between the various basic dyes in regard to fastness to light.

Other vegetable fibres can be dyed like cotton, with the exception of jute, which does not require any mordant.

Wool is dyed with the basic colours from a simple bath containing Glauber's salt or some other neutral salt. It takes full and bright shades, some of which are fairly fast to washing, but others are not; generally their fastness to light is better on wool than on cotton; some, however, are very fugitive, others are moderately fast, but scarcely any are quite fast to light.

Silk is dyed in a simple bath containing Glauber's salt or in what is known as a broken soap bath; it takes very fine shades, and is moderately fast to washing and light. The main difficulty is to dye level shades on silk, the affinity of the basic dyes for the fibre being very great; this can only be got over by dyeing at a low temperature, using weak dye baths and, in most cases, by not adding the whole of the dyestuff in one lot at the beginning of the operation, but in several lots at intervals during the progress of the dyeing; using plenty of Glauber's salt or soap in the bath also tends to greater evenness of colour.

**3. ACID DYES.**—The main characteristic of this group of dyes is that, with a few exceptions, they will not dye cotton, while they require, in dyeing wool and silk, the bath to be acid in character. There are several sub-groups into which the acid dyes can be divided. There is, first, those colouring matters which are sulphonated basic dyes, such as Acid Magenta, Acid mauve, Acid green, Acid violet, &c. These are a useful class of dyestuffs for wool and silk, on which they produce some fine tints of a solid character, usually fast to washing and dilute acids; some are fast to light. Indigo extract also belongs to this group of dyes. Then there are the group of Nitro dyes, of which Picric acid, Naphthol yellow, and Aurantia are the best examples; these are mostly yellow or orange dyes, giving very bright and full shades of a fair degree of resistance to washing, &c.

The Eosines are a small group of acid dyeing colouring matters,

which give very brilliant but fugitive shades of rose to bluish-rose tints on wool and silk from a weak acid bath. The Eosines are not much, if at all, used in garment dyeing.

The azo colours are by far the most numerous and important of the acid dyeing colouring matters. They include such dyes as the Scarlets, Ponceaus, Croceines, Oranges, Amaranth, Azorubine, Milling yellow, Azocarmine, Chromotrops, Naphthol blacks, Acid blacks, Fast reds, Cloth reds and Scarlets, Bordeaux, &c. They include some of the most brilliant and fugitive dyes, as well as the most useful and fast coal-tar colours; some of the Chromotrops are perfectly fast to light, while the Naphthol blacks and Acid blacks are exceedingly useful in garment dyeing, on account of the ease with which they may be dyed and the fastness of the colours to washing and light.

Some of the modern azo colours have the property of dyeing upon mordants, a property of which much advantage is taken in dyeing.

Jute may be dyed with many of the azo colours by boiling it in a bath containing a little alum. On cotton the Croceine scarlets may be dyed from an alum bath, but the results cannot be considered altogether satisfactory.

Generally the acid colours, especially the azo colours, are notable for their fastness to washing and acids; some are fast to alkalies, some are fast to light, and all have some considerable degree of resistance to that destructive influence.

**4. MORDANT DYES.**—The peculiarity of this group of dyestuffs, which includes both natural and artificial colouring matters, is that, generally, of themselves they do not possess any colour or dyeing property; to utilise them as dyestuffs, it is necessary to bring them into contact with a metallic compound, with the metal or oxide of which they enter into combination and form an insoluble coloured body, generally known as the colour lake, the formation of which, on any fibre, causes that to become dyed. As examples of this class of dyestuffs may be cited logwood, fustic, Brazil wood, cochineal, Alizarine, Alizarine yellows, Alizarine blues, Alizarine cyanines, Anthracene brown, Gambines, Chrome violet, Chrome blue, and other chrome colours, Gallocyanine, and many others.

Generally, these mordant dyes produce on mordanted fabrics shades which are remarkable for their fastness to washing, acids, alkalies, and light. An alizarine red excels all other colours in regard to its fastness to all influences, while most of the others closely approach it in this useful feature. This high power of resistance to all the destructive influences which go to destroy

the beauty of dyed fabrics, when exposed to all the vicissitudes of weather and wear, tend to make the mordant dyes a very important class of dyestuffs. Many examples of their use will be found in the recipes which are given below.

5. **INDIGO DYES.**— This is a small group comprising indigo and indophenol, which are dyed by special processes. These are not employed in garment dyeing, owing to sundry difficulties attending their application which render them unsuitable for this class of dyeing.

### 3. DYEING OPERATIONS AND DYEING MACHINERY.

Dyeing is invariably carried out in aqueous solutions of the various dyestuffs and mordanting materials ; sometimes these solutions are used cold, at other times at a moderately warm temperature, and at other times at the boiling point. In these liquors the fabrics, &c., to be dyed are immersed for a variable length of time, according to the character of the work to be done ; sometimes the immersion is only for a few minutes, at other times it extends into hours. During this immersion it is necessary that the fabrics, which are being treated, should be worked—that is, turned over and opened out from time to time, an operation which is intended to bring every part of the fabric in contact with the dye liquor, so that uniform and level shades are obtained ; this latter feature is one of great importance, as the finished goods must show an even shade of colour when looked at from all points of view ; the dyer must adopt all those precautions which will enable him to attain this end. Simple immersion of fabric in the dye liquor may result in the article becoming dyed, but the shade will be uneven, and there will be light and dark places.

This evenness of shade is obtained in dyeing by not only constantly turning over or working about the articles which are being dyed, but also by a careful selection of dyestuffs ; there are some dyes which are difficult to use, and tend to produce uneven shades ; such generally have a strong affinity for the various textile fabrics ; with the basic colours, for instance, it is difficult to produce level shades on silk and wool ; the Indulines are notoriously a group of dyestuffs that require care in manipulating ; on the other hand, there are some dyes, archil and cudbear, for example, which are easily dyed, and comparatively little difficulty is met with in producing even shades with them.

The character of the appliances which a dyer may use in his trade will largely depend upon the materials he has dyeing and

upon their quantity. The latter factor is a most important one, as the means which would be quite satisfactory, where the work is done on a limited scale, would prove very unsatisfactory in dealing with large quantities of articles.

When only small quantities of articles are being dealt with, and these only at the ordinary temperature, or at a luke-warm or hand heat, then the dyeing operations may be carried out in wooden or earthenware dye vessels, the actual manipulations being done by hand, wooden sticks (hickory wood makes the best sticks) being used. Earthenware dye vessels are the best, inasmuch as they cannot have any influence on the dye liquor, and are easily cleaned out; on the other hand, they cannot be obtained of any great size, and so can only be used for dyeing a few articles at a time. Wooden dye vessels can be obtained of any size; they have, as a rule, no influence upon the dye liquors, but, being of an absorbent nature, they become more or less impregnated with the various liquors, and, consequently, are not as cleanly to use or as easy to clean out as earthenware vessels; the same wooden dye vessel cannot be used to dye blacks and light rose pinks with equally good results.

When the dyeing has to be done at high temperatures, some means of heating the dye vessels must be adopted. In this case the best plan is to use dye vessels made of copper and heated by steam. Fig. 15 is a drawing of a dye kettle of the form generally used in garment dyeing. The lower portion of this is made double, and steam is passed into the jacket so formed from the steam pipe. A safety valve is, or should be, attached to this jacket; while there are taps for running away the condensed water which accumulates in the jacket, and for running off the dye liquor from the inside of the kettle.

Instead of employing a jacketted kettle, the heating may be done by steam passing through a coil of pipe running round the inside of the kettle close to the bottom. This is of simpler construction to the last, and is quite as efficient in use.

Where steam is not available, copper dye vessels heated by fire heat may be employed; but such are not so convenient in use, as they are not so clean and do not last as long, the heat of the fire sooner or later leading to their destruction by oxidisation of the copper.

Such dye vessels are made in a great variety of sizes, having

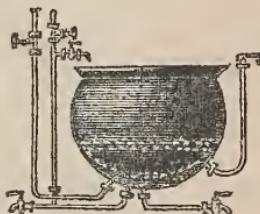


Fig. 15 —Dye kettle.

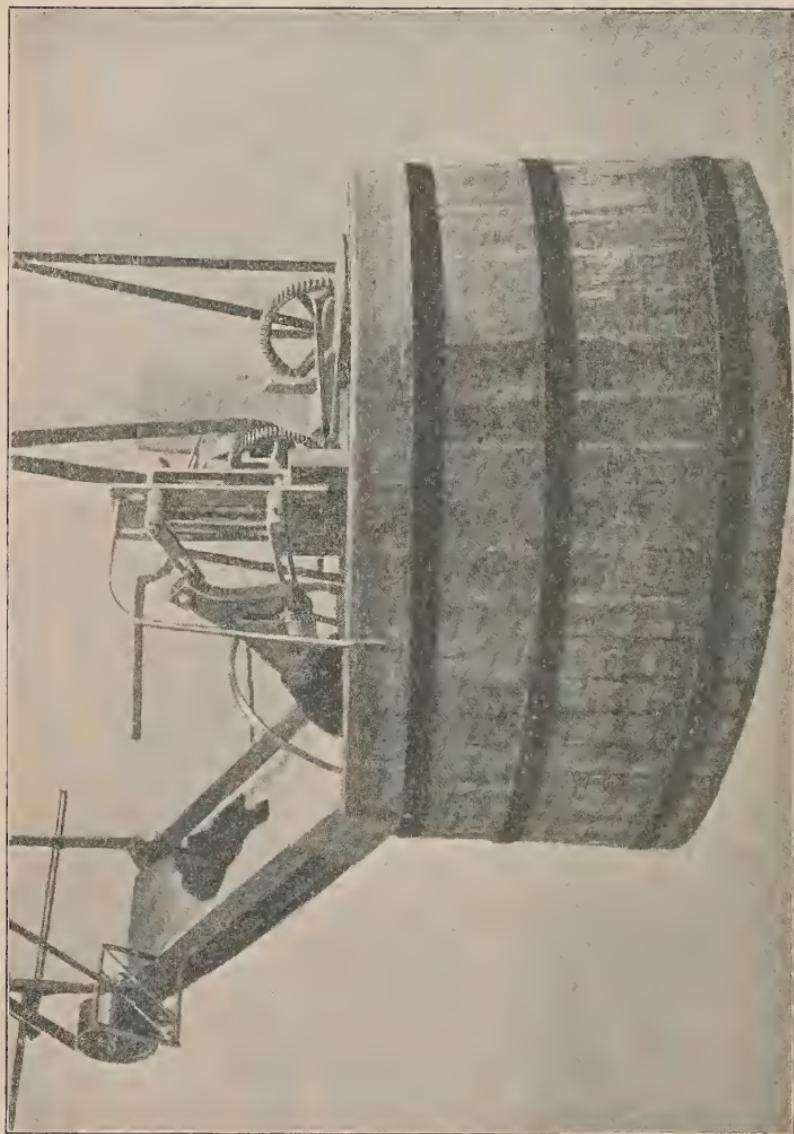


Fig. 16.—Garment dyeing machine.

capacities of from 5 to 250 gallons, the actual manipulations being done by hand with wooden sticks.

A very convenient garment dyeing machine is the Perth oval dyeing machine made by Messrs. Gorrie & Son, and in its latest form shown in Fig. 16. It consists of an oval shaped wooden tub fitted with the necessary steam pipes for heating it. The peculiarity of the machine is a set of four paddles, which extend from one side to the centre of the tub; when these are set in motion they generate a circular motion of the dye liquor and

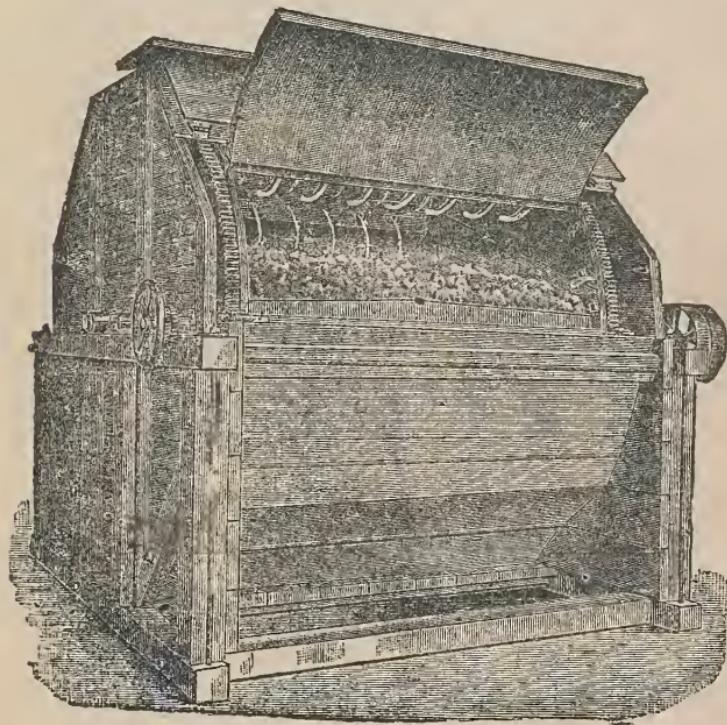


Fig. 17.—Delahunty's dyeing machine.

goods in the tub, which saves a great deal of manual labour in turning over the goods from time to time, while it ensures very uniform and level dyeing. In the latest form, shown in the drawing, there is an arrangement added for removing the garments from the machine when the operation is ended. This machine is made to deal with from 60 to 300 lbs. weight of garments at one time, and is certainly one of the most efficient dyeing machines made.

Where large quantities of garments have to be dyed, the Delahunty dyeing machine, shown in Fig. 17, will be found very useful. In this machine the articles are put in a central revolving cage with perforated sides; this is caused to revolve in the dye liquor which is contained in a semicircular dye trough. The whole arrangement is covered in by a wooden cover. The revolution of the cage causes the articles which are being dyed to turn over and over, and the turning over is facilitated by curved fingers which project inside the cage, as is seen in the drawing. With this machine there is a good deal of labour saved, less dyestuffs and chemicals are required (as the liquors are used somewhat stronger), while the dye liquors are more easily retained for future use. The filling of the machine only occupies a comparatively few minutes. After the dyeing is done, the door of the machine is opened, and the articles in the upper portion taken out; a slide door is now placed in the machine and the cage given half a revolution; this brings the rest of the articles to the top, and these are now taken out. There is little trouble in working to any given shade, as the articles in the machine can be readily inspected from time to time to see how the dyeing is progressing, and fresh portions of dye liquors can be added as required to bring up the shade.

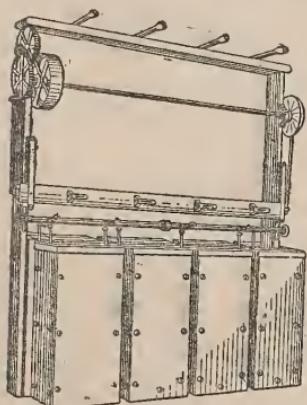


Fig. 18.—Silk dyeing boxes.

For the purpose of dyeing silks or laces, which are not able to stand the strain of the dyeing machines, dyeing boxes shown in Fig. 18, as made by Messrs. Gorrie, are used. These consist of tall, upright, wooden boxes, fitted with frames on which the silk, &c., is fastened. These frames are, by the gearing shown in the drawing, made to lift up and down in the dye liquor in the boxes. The latter are fitted with steam pipes and other necessary fittings. These boxes are found to work well, and the silks are perfectly dyed without any risk of damage to them.

The principal troubles of a garment dyer arise from the matching of shades and uneven dyeing. Matching shades is a very difficult operation in the case of re-dyeing old garments, and nothing we can state here will be of much use, as the dyer must learn the art of matching shades in the school of experience; one piece of advice to a garment dyer would be never to guarantee the pro-

duction of any given shade, but simply to try and get as near as possible to it. A good rule when matching shades is not to attempt to obtain the full shade all at once, but to gradually build it up, so to speak, in the process of dyeing; this plan will enable the dyer to watch the progress, and to add more or less dyestuff or colouring matters as he sees is required.

Uneven shades have been referred to before, and some hints given as to avoiding them; notwithstanding all the care which a dyer may take in dyeing garments, it is scarcely possible to avoid uneven places; these portions of a garment which are exposed to the most wear will probably come up lighter in colour than those places which are least worn, and the dyer will have a great deal of difficulty in overcoming defects arising from such causes. Then in some cases parts of the article may have been exposed to the action of light much more than other portions, and the original colour in such places will be much faded; such portions will generally come up light in re-dyeing, although in some cases they may come up darker.

Again, unclean and greasy garments are a fruitful cause of uneven dyeing, so that too much care cannot be exercised in the preliminary operations of cleansing fabrics before dyeing, for, unless all dirt, &c., is removed, even shades will not result.

In dealing with garments which are much faded, the best method of proceeding is to first of all thoroughly cleanse them in a soap bath, well rinsing in water afterwards; then prepare an acid bath with  $\frac{1}{2}$  pint of sulphuric acid and  $\frac{1}{2}$  lb. of oxalic acid mixed with 30 to 40 gallons of water; in this immerse the articles and handle them for 10 minutes, afterwards giving them a good rinse in hot water. Next sort the goods, placing those ready for dyeing from which the faded portions have been removed; those which were badly faded and the acid has not properly treated, are again entered into the bath, to which has been added 2 pints of nitrous acid; in this they are handled for 10 minutes, or longer if necessary, to cause them to become of a uniform shade. The nitrous acid gives them a faint yellow tint, which, however, will not prevent them from taking any shade that is to be subsequently dyed. In dyeing faded garments it is advisable not to boil them too long; more uniform results are obtained by keeping them below the boil, and using dyestuffs which will feed on to the materials at a low heat; thus, for instance, maroons are better dyed on faded woollen goods with Acid Magenta, Acid yellow, indigo extract, and Glauber's salt, with a little acid. Woollen dresses with silk trimmings are best dyed with cudbear below the boil. Greens are best dyed

at a gentle boil with Acid yellow, indigo extract, Glauber's salt, and sulphuric acid. Crimson, with Acid Magenta and cudbear below the boil.

#### 4. DYEING OF SILK DRESSES AND FABRICS.

The following recipes will be found to comprise all the principal shades which the dyer will have to produce on silk, and the use of all the most valuable dyestuffs which are at present known, will be described. The quantities given must not be too much relied on by the dyer, as, owing to the difficulties which are involved in a number of dresses or other fabrics, the sizes of which may vary very much, it is practically impossible to give definite quantities in recipes, and the garment dyer must be prepared to vary the quantities to suit the number and size of the goods he is dealing with. In some of the recipes no quantities are given; in such cases the dyer should prepare a solution of the dyestuffs named in the recipe, and add that solution in small quantities at a time into the dye bath until he has obtained the shade he requires.

1. **Rose on Silk.**—Prepare a bath containing (for two dresses or about the same quantity of other silk fabrics) 2 to 3 ozs. of a good soap and about  $\frac{1}{8}$  oz. of Safranine Prima; the goods are entered into this bath and worked for about half an hour at a temperature of  $140^{\circ}$  to  $150^{\circ}$  F.

2. **Rose on Silk.**—While the last method gives a fine shade of bluish rose, the colour has the disadvantage of not being fast to light; if  $\frac{1}{2}$  to  $\frac{3}{4}$  of an ounce of Rhodamine B, is used in place of the Safranine, a fine rose will be obtained which is much faster to light. Safranine pinks are also turned blue by acids whereas Rhodamine pinks are not affected.

3. **Rose on Silk.**—Prepare a bath of soap as before, add to this a little acetic acid and  $\frac{1}{4}$  oz. of Eosine G, the bath being used at the boil. This recipe will give a fine shade of rose, which is, however, fugitive to light. By varying the kind of Eosine used various tints of rose can be dyed, from a yellowish with Eosine G, to a bluish rose with Eosine BN, or with Erythrosine.

4. **Pink on Silk.**—This can be dyed in a bath containing 4 to 6 ozs. Glauber's salt, 1 oz. of acetic acid, and  $\frac{1}{2}$  oz. of Brilliant Croceine MOO, working at the boil. Magdala red gives a very good pink; some of the other azo scarlets can also

be used to dye pinks by using from a  $\frac{1}{4}$  to  $\frac{1}{2}$  an oz. of them to two or three dresses or their equivalent.

5. **Crimson on Silk.**—Prepare a dye bath with 1 lb. of soap, a little Magenta and a trace of Phosphine or Canary to tone down the blueness of the Magenta ; work at from 170° to 180° F. until the proper shade has been obtained ; if it be too light, add a little more of the dyestuff until the full shade is obtained ; then take the goods out and, after washing, pass through a weak acetic acid bath to brighten the colour ; then dry.

6. **Crimson on Silk.**—Dye in a bath at the boil containing 4 ozs. Glauber's salt,  $\frac{1}{2}$  oz. sulphuric acid, and 1 oz. Azo carmine. The shade of crimson so dyed is a very fine one, and is fast to washing and light.

7. **Crimson on Silk.**—In place of the Azo carmine given in the last recipe there may be used Bordeaux S, Amaranth, Azo rubine, Milling red R, Fast red ; these give good crimson shades of a high degree of fastness to light, &c.

8. **Cardinal on Silk.**—Make a dye bath with 2 ozs. soap,  $\frac{1}{4}$  oz. Safranine Prima, and  $\frac{1}{4}$  oz. Canary, working at 150° F. to shade. By adding a little more Safranine the shade will come up bluer, while a little more Canary will turn it to a yellow shade cardinal.

9. **Scarlet on Silk.**—Dye in a bath containing  $\frac{1}{2}$  lb. Titan scarlet CB, 1 lb. salt, and a little acetic acid, working at the boil. This gives a good shade of scarlet.

10. **Scarlet on Silk.**—Can be dyed in a bath containing 1 oz. Scarlet R, 4 ozs. Glauber's salt, and  $\frac{1}{4}$  oz. sulphuric acid ; the dyeing being done at the boil. By using the 2R, 3R, or OO Scarlets various shades of scarlet can be dyed.

11. **Scarlet on Silk.**—Dye with 1 oz. Chromotrop 2R, 4 ozs. Glauber's salt, and  $\frac{1}{4}$  oz. sulphuric acid. This gives a very fine scarlet which is very fast.

12. **Pale Bordeaux Red on Silk.**—Dye in a bath containing 1 oz. Orange extra, 4 ozs. Glauber's salt, and  $\frac{1}{2}$  oz. sulphuric acid, adding a little Acid Magenta to shade.

13. **Cherry Red on Silk.**—Make a dye bath, with  $\frac{1}{2}$  oz. sulphuric acid, 1 oz. Acid Magenta,  $\frac{3}{4}$  oz. Fast red A,  $\frac{1}{4}$  oz. Indigo extract, working at the boil.

14. **Cream on Silk.**— Prepare a soap bath, add a little Phosphine, Phosphine substitute or New Phosphine G, raise

the temperature to the boil, enter the silk goods and work for fifteen minutes ; then lift, wash, and dry. It takes but little of any of these dyestuffs to produce a cream ; therefore, the addition to the bath must be made with some caution or the shade of cream will come out too dark. Phosphine gives good full and bright shades, but is rather costly ; this, however, is a small point in this class of work ; the other dyestuffs are of more recent introduction and are cheaper.

15. **Cream on Silk.**—Another method of dyeing cream on silk is to use a bath containing a little annatto, turmeric, and soda, working at the boil to shade, then passing through a weak bath of acetic acid to revive the colour. Care must be taken not to add too much of the dyestuffs.

16. **Cream on Silk.**—Another plan is to make a dye bath with 1 lb. salt,  $\frac{1}{4}$  oz. acetic acid, and sufficient Chrysamine R, or Titan yellow Y, as will give the required shade, working at the boil. One advantage of using these dyestuffs is, that the bath need not be thrown away after being once used, but may be kept and used over and over again, adding a little colouring matter to replace that taken out of the bath, a little salt and a little water occasionally. Either dyestuff will give good cream shades, which possess a fair degree of resistance to washing, and are quite fast to light.

17. **Light Blue on Silks.**—The best dyestuffs to use for the production of light blues on silks are the Nicholson or Alkali blues ; these give bright tints of a variety of hues or tones which possess a fair degree of fastness against light, although strong washing with soap will remove them from the silk. These blues are made in a variety of shades, from a red shade of blue (Alkali blue 3R) to a pure blue (Alkali blue 7B), so that dyers have at their command an easy means of dyeing any particular tint of blue they may require and of any desired shade. To dye with these Alkali blues, prepare a bath with  $\frac{1}{2}$  oz. of Alkali blue of any mark, 4 ozs. of borax ; heat this to the boil, then enter the goods and work for thirty minutes ; then lift, and enter into a bath of 2 ozs. of sulphuric acid, which will cause the blue colour to become developed ; should the blue not come up deep enough, re-enter into the dye bath and work a little longer, adding, if necessary, a little more of the Alkali blue ; then again develop the blue by passing through the sulphuric acid bath. In case the passage through the acid causes the colour to come up too deep, enter the goods into a bath containing borax (about 2 ozs. will be sufficient) only, boil for ten to twenty minutes and then

raise the blue in the acid bath as before. When the proper shade has been developed, rinse well and dry. The dye bath need not be thrown away; by adding about half the quantity of borax and sufficient dye it may be used over again.

18. **Light Blue on Silk.**—Dye in a bath containing  $\frac{1}{4}$  oz. Soluble blue, 4 ozs. Glauber's salt, and a trace of acetic acid. The Soluble blues and the Cotton blues give similar shades, and are made in the same variety of marks as the Alkali blues; while somewhat faster to washing, they are not quite so fast to light as the latter.

19. **Deep Navy Blue on Silk.**—For this the dye bath is made with  $2\frac{1}{2}$  to 3 ozs. of Naphthol black 3B, 9 ozs. Glauber's salt, and 2 ozs. sulphuric acid, the dyeing being done at the boil. Should a brighter shade be required, use rather less of the Naphthol black and add a little Acid blue 4S, in its place.

20. **Deep Navy Blue on Silk.**—Make the dye bath with  $2\frac{1}{2}$  to 3 ozs. Acid black BB, 9 ozs. Glauber's salt, and 2 ozs. sulphuric acid, working at the boil.

21. **Medium Blue on Silk.**—Prepare a bath with 1 oz. Methylene blue, 9 ozs. Glauber's salt, and, after entering the silk goods, work at about  $170^{\circ}$  to  $180^{\circ}$  F. to shade.

22. **Medium Blue on Silk.**—Make a dye bath with 1 oz. Patent blue superior,  $\frac{3}{4}$  oz. sulphuric acid, and sufficient soap, working at the boil for half an hour. This gives a fine blue of a greenish tone.

23. **Dark Blue on Silk.**—Make the dye bath with 3 ozs. Thiocarmine R,  $1\frac{1}{2}$  ozs. sulphuric acid, and sufficient soap, working at the boil to shade.

24. **Medium Blue on Silk.**—Use  $1\frac{1}{2}$  ozs. Acid blue 4S, 9 ozs. Glauber's salt, and 2 ozs. sulphuric acid, working at the boil to shade.

25. **Peacock Blue on Silk.**—Dye with Alkali blue, or by using any of the recipes for light blues given above; then dye in a fresh bath with  $\frac{1}{2}$  oz. Acid green-blue shade, and 1 oz. of acetic acid.

26. **Green on Silk.**—Prepare a bath with  $\frac{3}{4}$  oz. of Green crystals Y, and a little acetic acid; heat this to about  $150^{\circ}$  F., enter the dresses and work to shade. This gives a fine green which keeps its colour fairly well by gas light.

27. **Olive Green on Silk.**—Prepare a bath with  $\frac{3}{4}$  lb.

cudbear, 1 lb. turmeric,  $\frac{1}{2}$  oz. Acid green,  $\frac{1}{2}$  lb. Glauber's salt and  $\frac{1}{2}$  oz. sulphuric acid; dye at the boil to shade.

**28. Bright Yellowish Green on Silk.**—Make the dye bath with  $\frac{3}{4}$  oz. Acid green, yellow shade,  $\frac{1}{4}$  oz. Fast yellow FY,  $\frac{1}{2}$  lb. Glauber's salt, and  $\frac{3}{4}$  oz. sulphuric acid, working at the boil to shade.

**29. Sea Green on Silk.**—Make the dye bath with 2 ozs Fast green, bluish, and 1 oz. sulphuric acid, working at the boil to shade.

**30. Bright Olive Green on Silk.**—Make the dye bath with  $2\frac{1}{2}$  to 3 ozs. Naphthol green B, 9 ozs. Glauber's salt, and 3 ozs. sulphuric acid, the dyeing being done at the boil.

**31. Brown on Silk.**—The dye bath is made with sufficient soap,  $\frac{1}{2}$  oz. sulphuric acid, 15 ozs. archil, 20 ozs. turmeric, and 9 ozs. indigo extract, working at the boil to shade. By afterwards passing the dresses through a weak acetic acid bath the colour will be brightened. By varying the proportion of indigo extract a great variety of shades of brown may be obtained from these three dyestuffs.

**32. Light Brown on Silk.**—Steep the garments for two hours in a bath of nitrate of iron at  $2\frac{1}{2}^{\circ}$  Tw., thin rinse and dye in a bath which contains 6 ozs. fustic extract, 4 ozs. turmeric, and 5 ozs. cudbear, working at the boil to shade. The addition of a little indigo extract would darken the shade.

**33. Medium Brown on Silk.**—Steep the silk goods in nitrate of iron at  $2\frac{1}{2}^{\circ}$  Tw. for two hours, then rinse. Prepare a dye bath with 1 lb. fustic extract,  $\frac{1}{2}$  lb. cudbear and 4 ozs. logwood extract, working at the boil for  $1\frac{1}{2}$  or two hours.

**34. Medium Brown on Silk.**—Prepare a bath with  $1\frac{1}{4}$  lbs. gambier and 1 oz. bluestone; work the dresses in this for two hours at a temperature of  $120^{\circ}$  to  $130^{\circ}$  F., then rinse, and pass into a bath of nitrate of iron at  $8^{\circ}$  Tw., steeping for one hour, this bath being used cold. Then rinse and pass into a bath containing  $1\frac{1}{2}$  ozs. Fast brown and 1 oz. acetic acid, working at the boil until the shade is developed; then wash and dry. The bath of gambier and bluestone is not exhausted and may be frequently used, adding from time to time fresh proportions of dyestuffs.

**35. Dark Brown on Silk.**—Prepare a bath of 20 ozs. cutch and 1 oz. bluestone; in this work the garments for three hours at a hand heat, then rinse and treat at about  $150^{\circ}$  F. in a bath

containing 2 ozs. bichromate of potash; work for one hour, then rinse and pass into a bath of nitrate of iron at 8° Tw., used cold; in this the garments are allowed to steep for two hours, after which they are taken out, rinsed, and dyed in a new bath containing 1½ ozs. Fast brown, 1 oz. Acid blue 4S, and 2 ozs. acetic acid, this bath being used at the boil. Work to shade, then lift, rinse, and dry.

36. **Silver Grey on Silk.**—Prepare a cold bath of 1½ ozs. tannic acid and  $\frac{3}{4}$  oz. tartaric acid; in this work the silk for half an hour, then lift and pass into a bath of nitrate of iron of about 2° Tw., working until the shade is fully developed, then lift, wash, and dry.

37. **Silver Grey on Silk.**—The dye bath is made with  $\frac{1}{4}$  oz. Naphthol black B, or  $\frac{1}{4}$  oz. Acid black S, 4 ozs. Glauber's salt, and  $\frac{1}{2}$  oz. sulphuric acid, working at the boil to shade. Either of these dyestuffs gives very good greys on silk; by using other brands of the Naphthol or Acid blacks than those given greys of various tones may be obtained.

38. **Lavender Grey on Silk.**—Make the dye bath with 1½ ozs. Sterosine grey and 1 oz. acetic acid; work at the boil to shade, then lift, wash, and dry.

39. **Silver Grey on Silk.**—An old method for dyeing grey on silk is in a bath containing  $\frac{1}{8}$  oz. of Alkali blue, 1 oz. cudbear, 4 ozs. borax, working at the boil for half an hour, then raising the colour by passing through a bath of acetic acid.

40. **Dark Grey on Silk.**—Prepare a cold bath of nitrate of iron at 2° Tw.; in this steep the silk garments for 1 hour, then take out, rinse lightly, and pass into a hand warm bath of 4 ozs. of logwood extract and a little alum to redder the tone slightly; work in this to shade. The addition of a little Methyl violet will brighten the shade if that be desired.

41. **Wood Grey on Silk.**—Prepare a lukewarm bath of alum at 2° Tw.; steep the goods in this for half an hour, then lift and add 3 ozs. copperas to the bath; re-enter the goods and turn them over for 15 minutes, lift, rinse, and dye in a bath made from 4 ozs. logwood extract and 2 ozs. sapan wood extract, working at about 140° F. to shade.

42. **Mauve on Silk.**—Dye in a bath which contains  $\frac{1}{2}$  oz. Violet 4 B,  $\frac{1}{4}$  oz. Magenta, and 2 ozs. Glauber's salt, working at about 180° F. to shade; then take out, rinse, and dry. By using different brands of the violet a variety of shades of mauve from a blue to a red may be dyed.

43. **Mauve on Silk.**—Make the dye bath with 1 oz. sulphuric acid, 4 ozs. Glauber's salt, and  $\frac{3}{4}$  oz. Acid mauve B, working at the boil to shade. A very nice shade of mauve is thus obtained; by adding a little Acid magenta the shade may be reddened, or by addition of a little Acid violet, the tone of the mauve may be turned a little bluer.

44. **Violet on Silk.**—Prepare a dye bath with 4 ozs. Glauber's salt and 1 oz. Violet. Work the garments in this at a hand heat for a short time, then heat slowly to the boil, and work until the full shade has been obtained. The dyer has a choice of Violet dyes, Methyl, Paris, Hoffmann, &c., which he may use; they are all dyed in the same way. By using various brands he may dye from a red-, almost crimson, with 3R Violet, to a very blue shade-violet, with a 5B Violet; practically, by making use of the two extreme red and blue violets and mixing these in various proportions, he may obtain any shade he requires.

45. **Violet on Silk.**—Make the dye bath with  $1\frac{1}{2}$  ozs. Acid violet, 4 ozs. Glauber's salt, and  $1\frac{1}{2}$  ozs. sulphuric acid, working at the boil to shade. The acid violets, like the neutral violets, are made in a variety of shades, from a red 3R to a blue violet 7B, by varying the particular brand used a great variety of shades may be dyed.

46. **Prune on Silk.**—Prepare a dye bath with 2 ozs. sulphuric acid, 4 ozs. Glauber's salt, 1 oz. Fast red, and 2 ozs. Acid violet 4B, working at the boil for one hour; then lift, wash, and dry.

47. **Bright Yellow on Silk.**—Prepare the dye bath with  $1\frac{1}{2}$  ozs. Fast yellow FY, 2 ozs. acetic acid; work at the boil for half an hour; then lift, wash, and dry.

48. **Yellow on Silk.**—Prepare a dye bath with  $1\frac{1}{2}$  ozs. Oxyphenine and 4 ozs. phosphate of soda; work the goods in this bath at the boil to shade; then lift, wash, and dry.

49. **Greenish Yellow on Silk.**—Prepare a dye bath with 2 ozs. Thioflavine T, 1 oz. acetic acid, and sufficient soap; in this work the garments at the boil to shade, then pass through a weak acetic acid bath to brighten the shade, rinse, and dry.

50. **Orange Yellow on Silk.**—Prepare a bath with 1 oz. Tartrazine,  $\frac{1}{2}$  oz. sulphuric acid and 4 ozs. Glauber's salt, working at the boil.

51. **Lemon Yellow on Silk.**—Prepare a bath with  $\frac{1}{4}$  oz. Azo yellow,  $\frac{1}{2}$  oz. acetic acid, and 4 ozs. Glauber's salt; work at the boil.

52. **Orange on Silk.**—Prepare a bath with 1 oz. Orange X,  $\frac{3}{4}$  oz. sulphuric acid, and 4 ozs. Glauber's salt, working at the boil to shade.

53. **Orange on Silk.**—Prepare a dye bath with 2 ozs. Titan orange and 4 ozs. phosphate of soda, working at the boil to shade.

54. **Black on Silk.**—Prepare a dye bath with 1 lb. Glauber's salt, 2 ozs. sulphuric acid,  $\frac{1}{2}$  lb. Acid black BB,  $\frac{1}{2}$  oz. Acid green, and  $\frac{1}{2}$  oz. Fast yellow FY, working in this bath at the boil to shade. This yields a very fine black, the tone of which may be varied by using more or less of the green and yellow.

55. **Black on Silk.**—Prepare a bath with 4 ozs. Naphthol black B,  $\frac{1}{2}$  oz. Naphthol green B, 8 ozs. Glauber's salt, and 2 ozs. sulphuric acid; in this the garments are worked at the boil for one to one and a-half hours, then lifted, washed, and dried.

56. **Black on Silk.**—Prepare a bath of nitrate of iron at  $5^{\circ}$  Tw., in which the silk goods are steeped for twelve hours; they are then lifted, rinsed, and dyed in a new bath made from 4 lbs. logwood and 1 lb. fustic; enter the silk at a handheat and work for half an hour; then raise the temperature to the boil, work for about twenty minutes, lift, add 2 ozs. soap to the bath, re-enter the goods, and work twenty minutes longer; finally lift, wash, and dry.

57. **Black on Silk.**—Prepare a bath of nitrate of iron at  $12^{\circ}$  Tw., in this steep the silk over night; lift, drain, and hang exposed to the air for two hours; then dye in a bath made from 5 lbs. logwood,  $\frac{3}{4}$  lb. turmeric, and  $1\frac{1}{2}$  oz. verdigris; the goods are entered at a temperature of  $100^{\circ}$  F., the heat raised slowly to the boil, worked to shade, lifted, rinsed, and dried.

58. **Black on Silk.**—Prepare a bath of iron liquor (pyrolignite of iron) at  $9^{\circ}$  Tw., and in this steep the silk overnight; the next day take out of the bath and hang in the air for three hours, then rinse. Prepare a dye bath with 5 lbs. logwood and 2 lbs. fustic; enter the silk into the bath at a temperature of  $100^{\circ}$  F., heat slowly to the boil, work to shade, then lift and wash.

59. **Black on Silk.**—For 10 lbs. weight of silk goods make the dye bath with 9 ozs. Naphthylamine black S,  $\frac{1}{4}$  oz. Tropæoline OO, 1 lb. Glauber's salt, and 2 ozs. acetic acid.

It may be pointed out here that silk goods dyed and heavily weighted with a logwood, iron, and tannin black cannot be

re-dyed a black with such acid blacks as Naphthol black, Naphthylamine black, or Acid black, and the dyer must re-dye them with a logwood black. To strip these black dyed silks sufficiently of the weighting materials as to enable them to be dyed with an acid black would only result in the destruction of the silk. Silk weighted with tin, as is now largely practised, may be dyed black fairly well with an acid black, but as the weighting tends to make the silk rotten great care is needed in handling them, and garment dyers and cleaners are wise if they will take no responsibility in connection with such fabrics.

60. **Pea Green on Silk.**—To dye 10 lbs. weight of silk, prepare the dye bath with  $1\frac{1}{4}$  lbs. Fast yellow S,  $2\frac{1}{2}$  ozs. Cyanole extra, 1 lb. Glauber's salt, and 2 ozs. acetic acid, working at the boil.

61. **Red Plum on Silk.**—Prepare the dye bath for 10 lbs. weight of silk from 6 ozs. Naphthol red C,  $\frac{3}{4}$  oz. Orange GG,  $\frac{1}{2}$  oz. Indigo blue N, 1 lb. Glauber's salt, and 2 ozs. acetic acid, working at the boil to shade.

62. **Dark Peacock Green on Silk.**—For 10 lbs. weight of silk goods make the dye bath from 5 ozs. Indigo blue N,  $1\frac{1}{2}$  ozs. Fast yellow S,  $\frac{3}{4}$  oz. Orange GG, 1 lb. Glauber's salt, and  $\frac{1}{2}$  ozs. acetic acid.

63. **Fawn Brown on Silk.**—Prepare the dye bath for 10 lbs. weight of silk from  $2\frac{1}{2}$  ozs. Tropaeoline OO,  $1\frac{1}{2}$  ozs. Lanafuchsine SG,  $\frac{3}{4}$  oz. Fast acid green BN, 1 lb. Glauber's salt, and 2 ozs. acetic acid, working at the boil to shade.

64. **Russian Green on Silk.**—For 10 lbs. weight of silk make the dye bath with  $2\frac{1}{2}$  ozs. Fast acid green BN,  $1\frac{1}{2}$  ozs. Orange GG, 1 lb. Glauber's salt, and 2 ozs. acetic acid, working at the boil to shade.

65. **Dark Slate on Silk.**—Prepare the dye bath for 10 lbs. silk from 2 ozs. Indigo blue N,  $\frac{3}{4}$  oz. Orange GG,  $\frac{1}{2}$  oz. Lanafuchsine SB, 1 lb. Glauber's salt, and 2 ozs. acetic acid.

66. **Turquoise Blue on Silk.**—For 10 lbs. silk goods prepare the dye bath with  $4\frac{1}{2}$  ozs. Fast acid green BN,  $1\frac{1}{2}$  ozs. Cyanole extra, 1 lb. Glauber's salt, and 2 ozs. acetic acid, working at the boil to shade.

67. **Sage on Silk.**—Prepare the dye bath for 10 lbs. silk from  $1\frac{1}{2}$  ozs. Orange GG,  $\frac{3}{4}$  oz. Cyanole extra, 1 lb. Glauber's salt, and 2 ozs. acetic acid.

68. **Salmon Rose on Silk.**—Make the dye bath for 10 lbs. of silk goods with  $\frac{3}{4}$  oz. Lanafuchsine SB,  $\frac{1}{2}$  oz. Fast yellow S, 1 lb. Glauber's salt, and 2 ozs. acetic acid.

69. **Terra Cotta Brown on Silk.**—Make the dye bath for 10 lbs. silk from  $4\frac{1}{2}$  ozs. Lanafuchsine SG, 6 ozs. Orange GG,  $\frac{1}{2}$  oz. Cyanole extra, 1 lb. Glauber's salt, and 2 ozs. acetic acid, working at the boil to shade.

70. **Sage Brown on Silk.**—Prepare the dye bath for 10 lbs. silk with  $2\frac{1}{2}$  ozs. Orange GG,  $\frac{1}{2}$  oz. Lanafuchsine SG,  $\frac{3}{4}$  oz. Cyanole extra, 1 lb. Glauber's salt, and 2 ozs. acetic acid.

71. **Nut Brown on Silk.**—Prepare the dye bath with  $2\frac{1}{4}$  ozs. Lanafuchsine SG,  $1\frac{1}{2}$  ozs. Indigo blue N,  $1\frac{3}{4}$  ozs. Tropæoline OO, 1 lb. Glauber's salt, and 2 ozs. acetic acid ; these quantities will dye 10 lbs. of silk.

These recipes will probably be found sufficient for the garment dyer in dealing with any silk fabrics which he may have to dye. Further information will be found in Knecht and Rawson's *Manual of Dyeing*, or in the author's *Silk Dyeing*, to which books the reader is referred.

72. **Bright Blue.**—Use  $4\frac{1}{2}$  ozs. Patent blue B, 1 lb. Glauber's salt, and 5 ozs. sulphuric acid. This gives a very fine blue of a good degree of fastness to light.

73. **Navy Blue.**—A good blue of a fair degree of fastness to light is got by using  $4\frac{1}{2}$  ozs. Cotton blue R, conc.,  $4\frac{1}{2}$  ozs. Nigrosine No. II., 1 lb. Glauber's salt, and 5 ozs. sulphuric acid.

74. **Rose.**—For a fine deep shade use 3 ozs. Violamine A2R, 1 lb. Glauber's salt, and 3 ozs. sulphuric acid. This is a strong bluish shade of rose ; by using Violamine G a yellowish rose can be dyed. These shades have a good degree of fastness to light.

75. **Olive Green.**—Make the dye bath with 3 ozs. Acid green, conc., 3 ozs. Nigrosine II., 1 lb. Glauber's salt, and 4 ozs. sulphuric acid. Gives a good fast green.

In dyeing silk dresses which have cotton linings in baths which contain sulphuric acid, it is important to observe three points—first, that too much acid be not used ; second, that the dyeing operations are not prolonged too much ; and third, that after dyeing the articles are well washed, or else the cotton is acted on by the acid, tendered, and made rotten.

## 5. DYEING HALF-SILK FABRICS, SATINS, &c.

A large number of fabrics are now made partly of silk and partly of cotton ; satin, for instance, is made with a silk warp and a cotton weft ; a large quantity of ribbons is now made in the same way. Occasionally the job dyer may have these articles to dye.

There are two methods which may be followed in dyeing half-silk fabrics ; the first is the oldest and consists in first dyeing the silk with an acid, or azo coal-tar colour or some other dye-stuff which will not dye the cotton, and then to mordant and dye the cotton with a basic aniline colour. By this method the fabric may, with the exercise of some care, be dyed in one colour ; or the fabric may be dyed in two colours, the silk in one and the cotton in another. By a careful selection of the particular colours, a fine shot or "*changeant*" effect may be obtained. The second method of dyeing makes use of the so-called Benzidin or Direct series of dyes, which will dye both cotton and silk uniform tints from the same bath. This, of course, is a more modern method than the last, and has only been available since about 1886, when the first of this class of dyestuffs was brought out ; some members of this class of dye-stuff will only dye silk in a neutral or faintly acid bath ; in a soap or alkaline bath they will not dye silk ; advantage may be taken of this property for the purpose of dyeing half-silk fabrics in two colours, by using such of the dyes as resist acid and dyeing the cotton in a soap bath, then subsequently dyeing the silk in an acid bath with an acid or azo colouring matter. Half-silk fabrics may be dyed with some of the natural colouring matters, but the process is so complicated and the results so unsatisfactory that this method has practically gone out of use.

In dyeing half-silk goods one or two colours with acid and basic coal-tar colours, the usual method of procedure is first to dye the silk in an acid bath with the required colouring matter. After being dyed the articles are well washed, laid down in a cold bath of tannic acid, passed through a cold bath of tartar emetic, again washed, and placed in the dye bath made with a basic colouring matter, this bath not being used higher than  $150^{\circ}$  to  $160^{\circ}$  F. ; the cotton then becomes dyed, and the silk may also take up a little colour, but this is somewhat loose and a subsequent bath of soap will remove it almost completely. The conditions of success are to use the tannic acid and tartar emetic baths cold ; the cotton will readily absorb the tannic acid

under these conditions, while the silk will scarcely be affected; the dyeing must be done at a low temperature, as then the silk will only take up a minimum quantity of the second dyestuff; generally it will take up a little but this can scarcely be avoided; this little will have some modifying action on the tint of the first colour which was dyed on the silk.

The following recipes will show how half-silk fabrics may be dyed by the methods just briefly noticed.

Half-silks may sometimes be dyed in a single dye bath with basic colouring matters; in this case the cotton is mordanted first, and then both cotton and silk are dyed together. Generally only pale tints can be dyed by this means.

1. **Dark Navy Blue on Half-Silk.**—Prepare a dye bath with 10 ozs. Glauber's salt and 3 ozs. Diamine blue black E; heat to the boil and work until the shade has been obtained.

2. **Dark Blue on Half-Silk Goods.**—First dye the silk with Victoria blue in a weak acid bath; next pass into a weak logwood bath for a few minutes, and then into a cold bath of 4 ozs. tannic acid and 3 ozs. tartaric acid, in which the articles are allowed to steep for three hours; after this they are passed into a cold bath of 3 ozs. copperas for half an hour, and finally dyed in a luke-warm bath with Methylene blue to shade.

3. **Navy Blue on Half-Silk Fabrics.**—Prepare a bath with  $1\frac{1}{2}$  lbs. indigo extract, 1 lb. cudbear, 5 ozs. Glauber's salt, and 2 ozs. sulphuric acid, working at the boil for two hours; then rinse, lay down in a bath of sumach over night, and fix in a bath of iron liquor at  $2^{\circ}$  Tw. for half an hour; dye in a new bath containing  $\frac{1}{2}$  oz. New Blue D, and a little Nigrosine, using this lukewarm and keeping the articles in until dyed to shade; finally, pass through a weak, warm soap bath.

4. **Light Blue on Half-Silk.**—Place the articles in a bath of tannic acid for three hours, then lift and fix by passing into a bath of tartar emetic for half an hour. The dyeing is done in a bath containing a little Cotton blue, working for half an hour at a hand heat, then slowly raising to the boil and working to shade.

5. **Rose on Half-Silk.**—Prepare a bath of 2 ozs. tannic acid; allow the articles to steep in this for two hours; lift, pass through a bath of  $1\frac{1}{2}$  ozs. tartar emetic for twenty minutes, and dye in a warm bath of Magenta, of which but little is required; turn the goods over until the proper shade has been obtained. In place of Magenta, Safranine may be used; this will give a

yellower tint; if Rhodamine be used a very bright rose pink will be obtained.

6. **Pink on Half-Silk.**—Prepare a bath with  $\frac{1}{4}$  oz. Titan pink 3B, and 8 ozs. of salt; enter the articles, and work for half an hour at the boil; then add a few drops of acetic acid, and work half an hour longer.

7. **Scarlet on Half-Silk.**—Prepare a bath with  $\frac{1}{4}$  lb. soap, 8 ozs. Glauber's salt, and 2 ozs. Diamine Scarlet B; work at the boil to shade.

8. **Bordeaux Red on Half-Silk.**—Dye the silk in a bath made with Orange, Acid Magenta, Glauber's salt, and sulphuric acid at the boil; then steep in a bath of tannic acid containing a little tartaric acid, fix in a bath of tartar emetic, and dye the cotton in a bath containing Safranine and Auramine.

9. **Yellow on Half-Silk.**—First dye the silk with Picric acid or Fast yellow FY, to shade in an acid bath; lay down in a bath of tannic acid, fix in a bath of tartar emetic, and dye in a bath of Auramine, Auramine G, or Benzoflavine. Picric acid dyes greenish yellows, and its tints can be matched with Auramine G for the cotton. Fast yellow FY dyes bright-yellow to orange-yellow shades, and its tints are best matched with Auramine II, or with Benzoflavine for the cotton.

10. **Yellow on Half-Silk.**—Prepare a bath with 2 ozs. Titan yellow Y, and 10 ozs. salt, working at the boil for half an hour; then rinse and dry.

11. **Yellow on Half-Silk.**—Make the dye bath with 2 ozs. Chrysophenine, and 10 ozs. salt; work at the boil to shade. The addition of a trace of acetic acid towards the end of the process will cause the silk to take up a little more colour.

12. **Grey on Half-Silk.**—Prepare a bath with 3 ozs. Sterosine grey and 3 ozs. acetic acid, working at the boil for half an hour. This grey is a very good one.

13. **Brown on Half-Silk.**—Prepare the dye bath with 10 ozs. of salt and 3 ozs. Mikado brown M; dye at the boil for one hour.

14. **Dark Brown on Half-Silk.**—Dye the silk brown with archil, turmeric, Acid green, and sulphuric acid in the usual way; then treat with tannic acid, and fix with tartar emetic as described above. Dye in a bath of Safranine, Methyl violet, and turmeric. The proportions of dyestuff can be varied according to the shade of the brown which is required.

15. **Bismarck Brown on Half-Silk.**—Lay down in a bath of

$1\frac{1}{4}$  lbs. cutch for four hours, turning over at intervals ; pass into a boiling bath of bichromate of potash ; and dye in a new bath with Bismarck brown and a little Magenta to shade.

16. **Yellow Brown on Half-Silk.**—Prepare a bath with  $1\frac{1}{4}$  lbs. of cutch, and allow the articles to steep in this for four hours ; pass into a boiling bath of bichromate of potash for ten minutes ; and dye in a bath of  $1\frac{1}{4}$  ozs. Bismarck brown and  $\frac{1}{2}$  oz. Chrysoidine at a gentle heat to shade ; then lift, wash, and dry.

17. **Violet on Half-Silk Goods.**—First mordant the cotton in a cold bath of tannic acid, fix in a bath of tartar emetic, and dye in a bath of Methyl violet, entering in the cold, then slowly raising to the boil. By using different brands of the Violet a variety of tints of violet may be dyed from a red shade to a blue shade violet.

18. **Medium Green on Half-Silk Goods.**—Dye the silk in a bath with 2 to 3 ozs. Methyl green and a little acetic acid ; pass into a lukewarm bath of 2 lbs. sumach and 4 ozs. fustic extract for two hours ; enter into a cold bath of 10 ozs. nitrate of iron and 2 ozs. tin crystals, working for ten to fifteen minutes ; and dye in a lukewarm bath of Methyl green to shade, wash, and dry.

19. **Dark Green on Half-Silk.**—Dye the silk in an acid bath with Acid green and turmeric ; lay down in a cold bath of tannic acid, fixing in a bath of iron liquor ; and dye with Brilliant green to shade.

20. **Black on Half-Silk Goods.**—First work the articles in a strong sumach bath for one hour ; pass them into a bath of nitrate of iron of  $8^{\circ}$  Tw., or into a bath of iron liquor at  $9^{\circ}$  Tw., and then into a boiling weak bath of bichromate of potash ; finally, dye in a bath of logwood. If necessary, repeat the operations.

21. **Black on Half-Silk.**—Steep over night in a bath of tannic acid ; fix in a bath of nitrate of iron ; pass into the tannic bath ; and dye in a bath of  $\frac{3}{4}$  lb. fustic,  $3\frac{1}{2}$  lbs. logwood, and  $\frac{1}{2}$  oz. verdigris at the boil ; then lift, wash, and dry.

22. **Orange on Half-Silk.**—Prepare a dye bath with 2 ozs. Benzo orange R, 3 ozs. phosphate of soda, and 3 ozs. soap ; work in this to the boil.

23. **Brown on Half-Silk.**—Prepare a bath with  $2\frac{1}{2}$  ozs. Direct orange RR,  $2\frac{1}{2}$  ozs. Benzoazurine G, 3 ozs. soap, and 5 ozs. phosphate of soda ; work at the boil to shade.

24. **Bronze Green on Half-Silk.**—Prepare a bath with Direct orange and Benzoazurine, &c., as in the last recipe ; then dye in

a new bath to shade with Malachite green, Auramine, and Chrysoidine.

Shot or *changeant* effects may be dyed on half-silk goods without very much trouble; the following recipes will be found of service, and will serve as guides to the methods of working:—

**25. Crimson and Green on Half-Silk.**—In this and the following recipes the first colour which is named is that of the silk, the second that of the cotton:—First, dye the silk in a bath of 2 ozs. Scarlet OOO, 8 ozs. Glauber's salt, and 2 ozs. sulphuric acid at the boil in the usual way. Then place in a cold bath of tannic acid; after steeping for four hours, fix in a cold bath of tartar emetic; rinse; dye at a gentle heat in a bath of 1 oz. Green crystals Y for one hour and a-half to two hours; then rinse, soap lightly, wash, and dry.

**26. Olive and Yellow on Half-Silk.**—The silk is dyed in a bath of 1 oz. Acid violet 6BN,  $\frac{1}{2}$  oz. sulphuric acid, and 8 ozs. Glauber's salt. Then the articles are placed in a cold bath of tannic acid, fixed with tartar emetic, and dyed in a fresh bath at a gentle heat with 1 oz. Auramine.

**27. Green and Crimson on Half-Silks.**—Dye the cotton in a bath with 1 oz. Diamine Fast yellow A, 5 ozs. Glauber's salt, 1 oz. phosphate of soda, and 1 oz. soap used at the boil. Then the silk is dyed in a bath of 1 oz. Acid green, 1 oz. Indian yellow, and 2 ozs. sulphuric acid, working at the boil. Next the articles are allowed to steep in a cold bath of tannic acid for two hours, fixed in a cold bath of tartar emetic, and dyed in a warm bath with 1 oz. Safranine Prima and  $\frac{1}{2}$  oz. No. 2 Magenta B.

**28. Yellow and Violet on Half-Silk.**—Dye the cotton in a bath of  $\frac{1}{2}$  oz. Diamine violet N, 5 ozs. Glauber's salt, 1 oz. phosphate of soda, and 1 oz. soap; the silk is dyed in a fresh bath with  $\frac{1}{2}$  oz. Fast yellow FY, 5 ozs. Glauber's salt, and 1 oz. sulphuric acid.

**29. Pink and Pale Green on Half-Silk.**—Dye the cotton with 1 oz. Diamine Fast yellow A, 5 ozs. Glauber's salt, 1 oz. phosphate of soda, and 1 oz. soap; then dye the silk in a fresh bath with a little Eosine GGF in a bath containing a little acetic acid.

**30. Grey and Black on Half-Silks.**—Dye the cotton in a bath of  $1\frac{1}{2}$  ozs. Diamine black BH, 1 oz. Diamine sky blue, 1 oz. Diamine orange D, 5 ozs. Glauber's salt, 1 oz. phosphate of soda, and 1 oz. soap. The silk is then dyed in a new bath of

1½ ozs. Thiocarmine R, ¼ oz. Formyl violet S4B, and 2 ozs. sulphuric acid.

31. Bright Blue and Orange on Half-Silk.—Dye the cotton in a bath of 2 ozs. Diamine orange D, 5 ozs. Glauber's salt, 1 oz. phosphate of soda, and 1 oz. of soap; the silk is afterwards dyed in a bath of Thiocarmine R and Formyl violet S4B with a little acid to shade.

The great development which has taken place during the past few years in the production of the Diamine and other series of direct dyes has placed in the hands of dyers of half-silk fabrics (satins) means of more easily dyeing these than was possible with the older dyes, and the garment dyer will do well to take advantage of them. Naturally, it may be expected that the affinity of these dyes for the two fibres (silk and cotton) composing these fabrics will vary very greatly. There are some which will dye the two equally well from the same neutral dye bath; there are others which will dye the cotton a deeper shade than the silk; there are many which will not dye the silk at all from a soap bath—such dyes are very useful if the dyer wishes to dye the cotton in one colour and the silk in another. Some of the dyes produce quite a different shade on the silk to what they dye on the cotton. In dyeing self colours on to satin goods with the aid of the Diamine dyes, it is often not possible to produce quite the same depth of shade on the silk as on the cotton; this difficulty may be got over by using in the same dye bath one or more of the acid series of dyes which have the property of dyeing the silk from a neutral bath. Again, by topping or passing the dyed fabrics through a second bath containing a basic dye, it is quite possible to dye up the silk to the same shade as the cotton.

The following are a few recipes which will illustrate the foregoing remarks, and show the garment dyer how these Diamine dyes may be applied in the dyeing of half-silk (satin) fabrics:—

32. Deep Orange on Half-Silk.—For 100 lbs. of half-silk goods use a dye bath made with 2 lbs. Diamine orange B, 10 lbs. Glauber's salt, and 2 lbs. phosphate of soda.

33. Violet on Half-Silk.—Prepare the dye bath for 100 lbs. weight of half-silk articles from 2 lbs. Oxydiamine violet B, 10 lbs. Glauber's salt, and 2 lbs. phosphate of soda.

34. Dark Green on Half-Silk.—100 lbs. weight of half-silk,

goods are dyed in a bath made from 2 lbs. Diamine green B, 10 lbs. Glauber's salt, and 2 lbs. phosphate of soda.

**35. Deep Rose on Half-Silk.**—The dye bath for 100 lbs. weight of half-silk articles is made from 2 lbs. Diamine red 10B, 10 lbs. Glauber's salt, and 2 lbs. phosphate of soda.

**36. Dark Cream on Half-Silk Goods.**—Make a dye bath for 100 lbs. weight of these goods from 1 oz. Diamine orange G, 5 lbs. Glauber's salt, and 1 lb. phosphate of soda; then pass into a fresh warm bath made with 1 oz. Orange GG,  $\frac{1}{2}$  oz. Indian yellow R, 5 lbs. Glauber's salt, and 1 lb. acetic acid, until the desired shade is obtained.

**37. Black-Brown on Half-Silk.**—A ground colour for 100 lbs. weight of half-silk articles is given in a bath made with 2 lbs. Cotton brown A, 1 lb. Diamine gold,  $3\frac{1}{2}$  lbs. Oxydiamine black SOOO, 15 lbs. Glauber's salt, and 5 lbs. phosphate of soda; then raise to the desired shade by topping in a bath of 4 ozs. New methylene blue N, 1 oz. Safranine, and  $\frac{1}{2}$  oz. Indian yellow G, at  $120^{\circ}$  F.

**38. Turquoise Blue on Half-Silk.**—A first dye bath for 100 lbs. weight of goods is made from 6 ozs. Diamine sky blue FF,  $\frac{1}{2}$  oz. Diamine fast yellow A, 10 lbs. Glauber's salt, and 3 lbs. phosphate of soda, after which the goods are topped in a fresh bath at  $150^{\circ}$  F., containing  $1\frac{1}{2}$  ozs. Cyanole extra and  $\frac{1}{4}$  oz. Brilliant green.

**39. Drab on Half-Silk.**—Prepare a bath for 100 lbs. weight of goods from 6 ozs. Diamine orange G, 1 lb. Diamine bronze G,  $\frac{3}{4}$  lb. Diamine brown M, 10 lbs. Glauber's salt, and 2 lbs. phosphate of soda; then, to bring up the shade, work at  $120^{\circ}$  to  $130^{\circ}$  F. in a fresh bath containing  $\frac{1}{4}$  oz. Aniline grey B and  $\frac{1}{4}$  oz. Bismarck brown FE.

**40. Leaf Green on Half-Silk.**—Make a dye bath for 100 lbs. weight of goods from  $\frac{1}{2}$  lb. Diamine black HW, 1 lb. Diamine fast yellow B, 10 lbs. Glauber's salt, and 2 lbs. phosphate of soda; then top in a fresh warm bath with  $\frac{1}{4}$  oz. Brilliant green,  $\frac{1}{4}$  oz. Indian yellow R,  $\frac{1}{2}$  oz. Thioflavine T, and  $\frac{1}{2}$  oz. Cyanole extra.

**41. Deep Rose on Half-Silk.**—The bottom colour is dyed on 100 lbs. weight of goods in a bath containing  $\frac{1}{2}$  lb. Diamine rose BD, 10 lbs. Glauber's salt, and 2 lbs. phosphate of soda; this is topped in a fresh bath with  $\frac{1}{4}$  lb. Rhodamine B and 1 oz. Safranine.

42. Cornflower Blue on Half-Silk.—A ground colour is given on 100 lbs. weight of goods in a bath made with  $2\frac{1}{2}$  lbs. Diamine azo blue 2B,  $1\frac{1}{2}$  ozs. Alkali blue 3B,  $\frac{1}{2}$  lb. Oxydiamine black SOOO, 10 lbs. Glauber's salt, and 2 lbs. phosphate of soda. The topping is done in a fresh bath at  $150^{\circ}$  F., containing 1 oz. Metaphenylene blue B, 2 ozs. New methylene blue R, and 1 oz. Indigo blue N.

43. Blue-Black on Half-Silk.—Prepare the dye bath with (for 100 lbs. weight of goods) 9 lbs. Union black S, 14 ozs. Diamine fast yellow B, 10 lbs. Glauber's salt, and 3 lbs. phosphate of soda; after this grounding bath pass into a fresh hot bath of  $\frac{1}{2}$  lb. Naphthylamine black S and 2 lbs. acetic acid.

## 6. DYEING WOOL GARMENTS, FABRICS, &c.

The dyeing of woollen articles constitutes by far the largest portion of a dyer's work. The dyer of woollens has at his disposal a far larger number of dyestuffs than has either the cotton or silk dyer; this is due to the fact that there are many dyestuffs which will dye wool but not cotton; and that wool is much more readily and easily mordanted with chrome and alumina mordants than is silk, so that more dyes may be applied to wool with the aid of mordants than can be applied to silk.

Without entering too much into detail it may be laid down broadly that three principles govern the application of the various colouring matters to wool. These three principles are the dyeing in a neutral bath, dyeing in an acid bath, and dyeing on mordants.

The *first principle* of dyeing is applicable to the basic series of coal-tar colours, of which Magenta, Safranine, Auramine, Brilliant green, Methyl violet, are examples; and to the so-called Congo or substantive colours, of which Benzopurpurine, Titan yellow, Diamine red, Chrysophenine, are examples. With these series of dyes the dye bath may contain the colouring matter only, or it may have in addition a quantity of common salt, Glauber's salt, or some other neutral salt, the dyeing being done just under the boil. Although the method of dyeing is practically the same, yet it is not advisable to mix together various members of these two groups of colours with the object of producing compound shades, good results not being thus obtainable. Still members of the same group may be mixed together; thus it is possible to obtain a fine scarlet by using a mixture of Safranine and Auramine; or a bright green, by using

a mixture of Auramine and Brilliant green; or an olive, by using a mixture of Methyl green and Bismarck brown; while, if the substantive colours are used, an orange is obtained by mixing Benzopurpurine and Chrysamine together; or a brown from Titan blue and Titan orange; yet it does not do to attempt to use Magenta and Chrysamine in the hope of dyeing an orange colour.

The *second principle* is the application of the colouring matters from an acid dye bath—that is, in addition to the dyestuff, the dye bath contains Glauber's salt and some sulphuric or acetic acid, according to the character of the dyestuff which is being used. The great majority of the dyestuffs which are applied in this way belong to the great group of azo coal-tar colours; some are acid derivatives of the basic colours; only one natural dyestuff, indigo extract, is applied in this manner. These acid colours have one property which is worth noting—viz., that many of them will not dye wool from a neutral bath, but if an acid is added then they will dye the wool. Advantage may be taken of this property in dyeing closely woven woollen goods by first treating in a neutral bath, then when the dye liquor has thoroughly penetrated into the fabric adding acid; in this way more level and uniform shades will be obtained than if the dyeing were started in an acid bath.

The *third principle* is where, owing to the nature of the colouring matter, the wool requires to be mordanted to properly develop and fix the colour upon the fibre. The mordants generally used are various compounds of chrome, iron, and alumina, other metallic bodies being rarely used. By the operation of mordanting, a deposit of oxide of the metal is formed on the fibre, and this combining with the colouring matter forms with it an insoluble coloured body, *colour lake* as it is usually called, on the fabric, and so dyes it. The particular colour which is so developed on the fibre depends not only upon the colouring matter, but also upon the mordant which is used. Thus, Alizarine dyed on an alumina mordant develops a scarlet, on a chrome mordant a dark red, on an iron mordant a dark violet. Again, Gambine with a chrome mordant gives a brown, while with an iron mordant it gives green shades. The mordanting is usually done before the dyeing, but it may be done after the dyeing; much, however, depends upon the character of the dyestuff which is used. There are some, such as Alizarine and Gambine, which have very little affinity for the fibre, and will, therefore, not dye unmordanted wool; on the other hand, there are some, such as logwood, fustic, and certain of the coal-

tar colours, which, having some affinity for the fibre, may be first dyed on, and then afterwards fixed by treatment with the mordant. This latter method has come into much use in connection with the application of fluoride of chrome as a mordant, used in conjunction with such dyes as Titan yellow, Diamine fast red F, Anthracene yellow, Milling yellow, Diamine brown, Chrome red, &c. This plan is sometimes styled the *stuffing and saddening method*. In some cases the dyeing and mordanting may take place in one bath. The members of this group of dyestuffs may be mixed together in any way to produce a great variety of compound shades, and an acid dyeing colouring matter may also be added to the dye bath to tone the colour. Generally speaking, the colours they dye are quite fast to washing and light; they possess a great resistance to acids and alkalies, and, on the whole, are the most satisfactory colours to use if fast shades are wanted. In the recipes which follow will be found many examples of the use of the so-called mordant colours.

A very large number of recipes for dyeing wool could be given, but we will select such only as comprise those shades which a dyer is most frequently called upon to dye; the methods given are of the most approved type.

1. **Black on Wool.**—Boil for one and a-half hours with  $2\frac{1}{2}$  lbs. copperas, 1 lb. tartar, and  $1\frac{1}{4}$  lbs. bluestone; rinse and dye in a fresh bath which contains 5 lbs. logwood, and  $\frac{1}{2}$  lb. fustic; enter the articles at a lukewarm heat, work well, then raise slowly to the boil, and maintain at that heat for two hours. To obtain colours from mordant-dyeing dyestuffs which will be fast to rubbing, to soaping, and have a good solid appearance, it is necessary that the dye bath be started cold or, at most, a lukewarm heat; then, after the goods have been turned over in this bath for a short time, the temperature is raised to the boil, not too quickly, and kept at that heat for one and a-half to two hours; this boiling serves to fix the colour on the wool.

2. **Bluish-black on Wool.**—Mordant by boiling for one and a-half hours in a bath which contains  $\frac{1}{2}$  lb. bichromate of potash, 6 ozs. bluestone, and 6 ozs. sulphuric acid; then rinse and dye in a new bath which is made from 5 lbs. logwood, and  $\frac{1}{2}$  lb. fustic, working as in the last recipe.

3. **Black on Wool.**—Prepare a bath with 7 lbs. logwood, 1 lb. fustic,  $\frac{1}{2}$  lb. sumach, and  $\frac{1}{4}$  lb. tartar; in this boil the goods for two hours, then lift, and add to the bath  $1\frac{1}{2}$  lbs. copperas, and  $\frac{1}{4}$  lb. bluestone; re-enter the goods, and work at the boil until the black has been developed; lift, wash, and dry.

4. **Black on Wool.**—Prepare a dye bath with 1 lb. Glauber's salt, 4 ozs. sulphuric acid, 6 ozs. Naphthol black B,  $\frac{1}{2}$  oz. Naphthol yellow S, and  $\frac{1}{4}$  oz. Naphthol green B; work at the boil until the articles are dyed a full black.

5. **Black on Wool.**—Prepare a dye bath with 6 ozs. Acid black S,  $\frac{1}{2}$  oz. Fast yellow FY,  $\frac{1}{4}$  oz. Acid green,  $\frac{1}{2}$  lb. Glauber's salt, and 4 ozs. sulphuric acid, working at the boil to shade.

The last two recipes are typical of the use of coal-tar blacks in the dyeing of woollen garments; besides the two mentioned, others, such as Victoria black, New Victoria black, Azo black, Wool black, Anthracite black, Naphthylamine black D, may be used. None of them by themselves dye a full jet black, but blacks of a more or less bluish tone; by the addition, however, of a little yellow or green dyestuff, as used in the recipes given above, these blacks may be used to dye full jet black shades. These coal-tar blacks have the advantage over logwood of leaving the fibre softer in feel and more lustrous in colour; they take less time to dye; while they are faster to acids than logwood blacks, and are generally fast to light. They are well worth the attention of garment dyers for wool and silk goods.

6. **Black on Woollen Dress with Silk Trimmings.**—Occasionally the dyer is called upon to dye a woollen dress which has some silk trimmings on it. To do this so that both the wool and the silk shall be dyed a uniform shade of black is by no means easy. The dress should be thoroughly cleansed in soap, well rinsed afterwards, and then passed through an acid bath. Next a hot bath is made with 1 lb. copperas, 2 ozs. argol, 2 ozs. bluestone, and 1 oz. fustic extract; in this the dress is allowed to steep for two hours, turning over at intervals, then taken out, exposed to the air for half an hour, and rinsed in water. Prepare a dye bath with  $1\frac{1}{2}$  lbs. logwood, and 1 oz. soap; enter the goods into this, and work for fifteen minutes at the boil; then allow to steep in the hot, but not boiling, bath for one hour; lift, wash, and dry. As a rule, the best results will be obtained when the two baths are used under the boil.

7. **Black on Wool.**—Prepare a dye bath with 5 ozs. Chromotrop S, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid; work at the boil for one hour, lift the goods, and add 3 ozs. bichromate of potash to the bath; re-enter the goods, and work half an hour longer at the boil. This gives a good black of a bluish tone, which has the merit of being fast to acids, washing, and light.

8. **Claret on Wool.**—Prepare a dye bath with  $1\frac{1}{2}$  lbs. cudbear,  $\frac{1}{4}$  oz. Acid magenta,  $\frac{1}{4}$  oz. Indigo extract,  $\frac{1}{4}$  oz. Atlas orange,

3 ozs. Glauber's salt, 2 ozs alum, and  $1\frac{1}{2}$  ozs. tartar. Work the goods in this at the boil to shade.

9. **Crimson on Wool.**—A very fine bright shade of crimson is dyed with  $1\frac{1}{2}$  ozs. Fast acid violet R, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid.

10. **Crimson on Wool.**—Prepare a bath with 2 lbs. cochineal,  $\frac{1}{2}$  oz. Acid magenta, blue shade, 6 ozs. Glauber's salt, 4 ozs. cream of tartar, and  $\frac{1}{2}$  pint of muriate of tin, working at the boil to shade.

11. **Maroon on Wool.**—Prepare a dye bath with  $1\frac{1}{2}$  ozs. Azo yellow,  $2\frac{1}{2}$  ozs. Fast acid violet R,  $\frac{1}{4}$  oz. Acid violet 5BF, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid.

12. **Dark Maroon on Wool.**—This can be dyed in a bath of  $2\frac{3}{4}$  ozs. Fast acid violet R,  $1\frac{3}{4}$  ozs. Azo yellow,  $\frac{3}{4}$  oz. Acid violet 5BF, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid, working at the boil for one and a-half hours.

13. **Scarlet on Wool.**—Prepare a bath with  $1\frac{1}{2}$  lbs. cochineal,  $\frac{1}{2}$  oz. Acid yellow,  $\frac{3}{4}$  lb. tartar,  $\frac{1}{2}$  oz. oxalic acid, and half pint of muriate of tin. Enter the goods into the bath at about  $170^{\circ}$  F., then heat to the boil and work to shade.

14. **Scarlet on Wool.**—Prepare a dye bath with 2 ozs. Wool scarlet OO, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid ; work at the boil to shade.

15. **Scarlet on Wool.**—The dye bath is made with 2 ozs. Chromotrop 2R, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid, working at the boil to shade.

16. **Scarlet on Wool.**—Prepare a dye bath with 3 ozs. Titan scarlet S, 20 ozs. salt, and 1 oz. acetic acid ; the dyeing is done at the boil.

17. **Scarlet on Wool.**—Prepare the dye bath with 2 ozs. Diamine scarlet B, 10 ozs. Glauber's salt, and work at the boil to shade.

In the last few recipes are shown the application of the Azo and Direct Scarlets to the dyeing of woollen garments; by using other dyes than those named, a variety of different shades or tints of scarlet may be dyed, but the above recipes give those dyes which will be found to yield the best results. The shades obtained with any of these are very bright and solid in appearance ; they are all fast against washing, the Chromotrop Scarlet fairly so against light ; the Direct Scarlets are not so fast, but will resist a fair account of exposure. The Titan

scarlet will resist acids, but the Diamine scarlet will not; generally, the Azo scarlets are fairly fast to acids.

18. **Maroon on Wool.**—Make a dye bath with  $1\frac{1}{2}$  ozs. Acid magenta, 2 ozs. Orange G,  $\frac{1}{2}$  lb. indigo extract,  $\frac{1}{2}$  lb. Glauber's salt, and 4 ozs. sulphuric acid; work at the boil to shade.

19. **Dark Red on Wool.**—Prepare a dye bath with 3 ozs. Titan red 6B, 20 ozs. salt, and 1 oz. acetic acid, working at the boil to shade.

20. **Red on Wool.**—Make a dye bath with 2 ozs. Bordeaux S, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid; work at the boil to shade. This gives a fine cherry red, which has the merit of being fast to acids and light.

21. **Deep Red on Wool.**—Prepare a dye bath with 2 ozs. Amaranth, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid, working at the boil to shade.

22. **Prune on Wool.**—The dye bath is made with  $\frac{3}{4}$  lb. indigo extract,  $\frac{1}{4}$  oz. picric acid,  $\frac{1}{4}$  oz. Acid magenta,  $\frac{1}{2}$  lb. salt, and 4 ozs. sulphuric acid, working at the boil for about one hour.

23. **Bordeaux Red on Wool.**—Prepare a dye bath with 10 ozs. Glauber's salt, 3 ozs. sulphuric acid, 1 oz. Ponceau 3R,  $1\frac{1}{2}$  ozs. Bordeaux S,  $\frac{1}{2}$  oz. indigo extract; enter the goods into the bath at a temperature of  $150^{\circ}$  F., heat to the boil, and work to shade.

24. **Bronze Brown on Wool.**—Mordant the woollen goods by boiling for one and a-half hours in a bath containing 3 lbs. alum,  $\frac{3}{4}$  lb. tartar, and  $\frac{3}{4}$  lb. bichromate of potash; rinse, and enter in the cold into a fresh dye bath which contains 10 lbs. fustic, 1 lb. logwood, and 3 lbs. madder; heat slowly to the boil, and work for one and a-half to two hours; then lift, wash, and dry.

25. **Bronze Brown on Wool.**—Prepare a dye bath with  $\frac{3}{4}$  oz. Patent blue V,  $\frac{3}{4}$  oz. Fast acid violet R, 1 oz. Azo yellow, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid, working at the boil to shade.

26. **Dark Brown on Woollen Goods.**—Prepare a bath with 5 lbs. fustic, 1 lb. logwood, 8 lbs. sanders wood, and 2 lbs. sumach; enter the goods and work for two hours at the boil; lift, add  $\frac{1}{2}$  lb. bluestone, re-enter the goods and work for forty-five minutes at the boil; again lift, add 1 lb. copperas, re-enter the goods and work from three-quarters to one hour longer; lift for the third time, wash, and dry.

27. **Medium Brown on Wool.**—Prepare a dye bath with  $\frac{1}{2}$  lb. fustic extract, 5 ozs. cudbear, 1 oz. copperas,  $\frac{3}{4}$  oz. bluestone; enter the goods at a hand heat, work for half an hour, then raise to the boil, and work to shade; lift, wash, and dry.

28. **Seal Brown on Wool.**—Prepare a dye bath with  $\frac{3}{4}$  lb. fustic extract, 7 ozs. cudbear,  $1\frac{1}{4}$  ozs. copperas, 2 ozs. logwood, and 1 oz. bluestone; work the dresses in this for fifteen minutes, raise slowly to the boil, and work to shade; then lift, wash, and dry.

29. **Brown on Wool.**—Mordant the goods by boiling for one and a-half hours in a bath with  $1\frac{1}{2}$  lbs. alum,  $\frac{3}{4}$  lb. tartar,  $\frac{1}{2}$  lb. bichromate of potash, then lift and rinse; the goods are next entered into a dye bath made with 6 lbs. Brazil wood,  $2\frac{1}{2}$  lbs. fustic, and 1 lb. logwood, worked half an hour at about hand heat, then slowly raised to the boil, and worked to shade.

30. **Dark Brown on Wool.**—Prepare a dye bath with  $\frac{3}{4}$  lb. indigo extract,  $\frac{1}{2}$  lb. fustic extract,  $\frac{3}{4}$  oz. Acid yellow, 1 lb. cudbear,  $\frac{1}{2}$  lb. alum, and  $\frac{3}{4}$  lb. tartar, working at the boil to shade.

31. **Dark Brown on Wool.**—Prepare the dye bath with  $1\frac{1}{2}$  ozs. Titan brown Y,  $1\frac{1}{2}$  ozs. Titan blue 3B, 20 ozs. salt, and  $\frac{1}{2}$  oz. acetic acid, working at the boil to shade.

32. **Chestnut Brown on Wool.**—Prepare a dye bath with 2 ozs. Titan brown Y, 1 oz. Titan yellow Y,  $1\frac{1}{2}$  ozs. Acid blue 4S, and 5 ozs. acetate of ammonia, working at the boil to shade.

33. **Walnut Brown on Wool.**—Prepare the dye bath with 3 ozs. Titan brown R, 2 ozs. Acid blue 4S, and 5 ozs. acetate of ammonia, working at the boil for one hour; then lift, wash, and dry.

34. **Olive on Wool.**—Prepare a bath with 12 lbs. fustic,  $2\frac{1}{2}$  lbs. logwood, 1 lb. madder, 1 lb. sumach, and 1 lb. tartar; work the goods in this at the boil for one and a-half hours; lift, add  $\frac{3}{4}$  lb. bluestone, re-enter the goods, work for half an hour longer; lift again, add 1 lb. copperas, re-enter the goods, and work at the boil to shade.

35. **Bright Olive on Wool.**—Prepare a dye bath with 2 ozs. Patent blue V,  $\frac{1}{2}$  oz. Fast acid violet R,  $1\frac{1}{2}$  ozs. Azo yellow, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid, working at the boil to shade.

36. **Bottle Green on Wool.**—Prepare a dye bath with  $1\frac{3}{4}$  ozs. Patent blue V,  $\frac{3}{4}$  oz. Fast acid violet R, 3 ozs. Azo yellow, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid.

**37. Dark Green on Wool.**—Prepare a dye bath with  $1\frac{1}{2}$  lbs. indigo extract,  $\frac{1}{2}$  lb. cudbear, 1 oz. picric acid, 5 ozs. Glauber's salt, and 2 ozs. sulphuric acid, working at the boil to shade.

**38. Sage Green on Wool.**—Prepare a dye bath with 1 lb. indigo extract, 1 oz. picric acid,  $\frac{3}{4}$  oz. *Tropaeoline* (red shade), 8 ozs. Glauber's salt, and 3 ozs. sulphuric acid, dyeing at the boil to shade.

**39. Olive on Wool.**—Prepare a dye bath with 1 oz. Fast yellow,  $1\frac{3}{4}$  ozs. Naphthol yellow S, 8 ozs. indigo extract, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid, working at the boil to shade.

**40. Night Green on Wool.**—Prepare the dye bath with 2 ozs. Acid green B, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid, working at the boil to shade.

**41. Light Green on Wool.**—Prepare a dye bath with  $\frac{3}{4}$  lb. indigo extract,  $1\frac{1}{2}$  ozs. Acid green,  $1\frac{1}{2}$  ozs. picric acid, 3 ozs. sulphuric acid, and 10 ozs. Glauber's salt, working at the boil for one hour; then lift, wash, and dry.

**42. Medium Green on Wool.**—Prepare a dye bath with 1 lb. indigo extract, 2 ozs. picric acid,  $1\frac{1}{2}$  ozs. Acid green,  $\frac{3}{4}$  lb. Glauber's salt, and 3 ozs. sulphuric acid, working at the boil to shade.

**43. Deep Green on Wool.**—Prepare a dye bath with 3 ozs. Patent blue V,  $\frac{1}{2}$  oz. Fast acid violet R,  $1\frac{1}{2}$  ozs. Azo yellow,  $\frac{3}{4}$  oz. Acid violet 5BF, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid, working at the boil to shade; then lift, wash, and dry.

**44. Dark Green on Wool.**—Prepare a dye bath with 1 oz. Titan yellow Y, 1 oz. Titan blue 3B, 20 ozs. salt, and  $\frac{1}{2}$  oz. acetic acid, working at the boil to shade; then lift, wash, and dry.

**45. Green on Wool.**—Prepare a dye bath with  $1\frac{1}{2}$  ozs. Titan yellow Y, 1 oz. Acid blue 4S, and 5 ozs. acetate of ammonia, working at the boil to shade.

**46. Moss Green on Wool.**—Mordant the wool by boiling for one and a-half hours in a bath containing  $3\frac{1}{2}$  ozs. bichromate of potash, 10 ozs. alum, and 2 ozs. sulphuric acid; then rinse, and dye in a new bath containing 2 lbs. fustic, 12 ozs. logwood, and 7 ozs. Brazil wood, working at the boil for one and a-half hours, then lift, wash, and dry.

**47. Bright Green on Wool.**—Prepare the dye bath with 10 ozs. Glauber's salt, 2 ozs. sulphuric acid, 3 ozs. Azo yellow,

and 2 ozs. Acid green B, working at the boil for about half an hour.

Given the three colours yellow, red, and blue, it is astonishing what a range of shades of browns, reds, greens, greys, blues, drabs, &c., a dyer may produce from them. In the recipes given above the dyer will find several examples of such shades being produced from the same three colouring matters. It is one of the arts of a dyer to be able to produce from a few colours a great range of shades, and to know, as the dyeing progresses, what colour to add to bring up the colour of the goods to the required shade; this art cannot be taught from books, it must be learnt in the school of experience and by close observation on the part of the dyer as to the effect produced by the addition of one or the other colour to an already existing combination of colours. The following dyes will be found very serviceable by the wool dyer to use either alone or in combination to produce colours of various tints:—Azo yellow, Acid yellow, turmeric, fustic, Brilliant scarlet, Fast acid violet R, Diamine fast red F, Acid Magenta, archil, cudbear, Brazil wood, Alizarine, Patent blue V, Cyanole, Acid violet, indigo extract, logwood.

48. **Bright Blue on Wool.**—Prepare a dye bath from 3 ozs. Alkali blue 3B and 10 ozs. borax; enter the goods in this, and work at the boil for half an hour; then lift, and pass into a bath of sulphuric acid to develop the blue. In the section on silk dyeing (p. 70) will be found some notes bearing on the dyeing of Alkali blues.

49. **Navy Blue on Wool.**—Mordant the wool by boiling in a bath containing 4 ozs. bichromate of potash and 3 ozs. tartar for one and a-half hours; then lift, rinse, and enter into a dye bath containing 2 lbs. Alizarine blue SW and 1 oz. acetic acid; enter cold, then raise slowly to the boil, and work for one and a-half hours; then lift, wash, and dry. This gives a full navy shade which is very fast.

50. **Navy Blue on Wool.**—Mordant by boiling in a bath of 4 ozs. bichromate of potash and 3 ozs. tartar; then dye in a fresh bath containing 1 lb. cudbear and 4 lbs. logwood, working at the boil for one and a-half hours; then lift, wash, and dry.

51. **Bright Blue on Wool.**—Prepare a dye bath with 2 ozs. Patent blue V, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid, working at the boil for one hour; then lift, wash, and dry. This will give a very bright blue of a slight greenish tone.

52. **Dark Blue on Wool.**—Prepare a dye bath with  $2\frac{3}{4}$  ozs.

Patent blue V,  $\frac{1}{2}$  oz. Fast acid violet R,  $\frac{1}{2}$  oz. Azo yellow, 1 oz. Acid violet 5BF, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid, working at the boil to shade.

53. **Navy Blue on Wool.**—Prepare a dye bath with  $3\frac{1}{2}$  ozs. Patent blue V, 1 oz. Fast acid violet R,  $\frac{1}{4}$  oz. Azo yellow,  $1\frac{1}{2}$  ozs. Acid violet 5BF, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid, working at the boil to shade.

54. **Blue on Wool.**—Prepare the dye bath with 4 ozs. Acid blue 4S, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid, working at the boil to shade.

55. **Light Blue on Wool.**—Prepare a dye bath with 1 lb. extract of indigo,  $\frac{3}{4}$  lb. alum,  $\frac{1}{2}$  oz. tartar, and 2 ozs. sulphuric acid, working at the boil to shade.

56. **Peacock Blue on Wool.**—Prepare a dye bath with  $1\frac{3}{4}$  lbs. indigo extract,  $\frac{1}{2}$  lb. Glauber's salt, 3 ozs. sulphuric acid, and  $\frac{1}{4}$  oz. picric acid, working at the boil to shade.

57. **Turquoise Blue on Wool.**—Prepare a dye bath with  $1\frac{1}{2}$  ozs. Turquoise blue, 10 ozs. Glauber's salt, and work at a little under the boil to shade.

58. **Sky Blue on Wool.**—Make the dye bath with  $\frac{1}{2}$  oz. Patent blue B, 10 ozs. Glauber's salt, and  $\frac{1}{2}$  oz. sulphuric acid, working at the boil to shade.

59. **Violet on Wool.**—Prepare a dye bath with 1 oz. Acid violet 5BF, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid, working at the boil to shade. By using other brands of Acid violets a variety of different shades of violet may be dyed.

60. **Silver Grey on Wool.**—Prepare a dye bath with  $\frac{1}{4}$  oz. Induline A, 10 ozs. Glauber's salt, and 1 oz. sulphuric acid, working at the boil to shade. Induline gives very good greys, but is not suitable for dyeing dark shades on garments, as it is not easy to obtain level shades with it.

61. **Dark Grey on Wool.**—Prepare a bath from  $\frac{3}{4}$  lb. logwood and  $\frac{3}{4}$  lb. galls; enter the wool into this and work for half an hour at the boil; then lift, add  $\frac{1}{2}$  lb. copperas, re-enter the goods, and work for half an hour longer.

62. **Grey on Wool.**—Prepare a dye bath with  $\frac{1}{2}$  oz. Acid blue 4S,  $\frac{1}{4}$  oz. Titan red, and 5 ozs. acetate of ammonia, working at the boil to shade.

63. **Drab on Wool.**—The dye bath is made with  $1\frac{1}{2}$  lbs. madder, 6 ozs. galls,  $2\frac{1}{2}$  ozs. extract of fustic, and  $\frac{3}{4}$  lb. Tartar;

enter the goods and work at the boil for one hour; then lift, add  $\frac{1}{2}$  lb. copperas, re-enter the goods, and work to shade.

64. **Yellow on Wool.**—Prepare a dye bath with 2 ozs. Azo yellow, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid, working at the boil.

65. **Yellow on Wool.**—Prepare a dye bath with 3 ozs. Titan yellow, 20 ozs. salt, and  $\frac{1}{2}$  oz. acetic acid. Work at the boil for one hour.

66. **Old Gold on Wool.**—Dye a yellow as in the last recipe, then lift and add 3 ozs. fluoride of chrome to the bath, re-enter the goods, and work for half an hour longer at the boil.

67. **Bright Yellow on Wool.**—Prepare a bath with 1 oz. Thioflavine T, and 10 ozs. Glauber's salt; enter the goods and work at the boil to shade. While the other recipes for yellow will give some orange tones of yellow, this will give a greenish yellow. Any of these yellows will, if used in sufficiently small proportions, give good straw shades or lemon shades of yellow.

68. **Deep Crimson on Wool.**—Make the dye bath for 100 lbs. weight of goods, using  $2\frac{1}{2}$  lbs. Naphthol red C,  $\frac{3}{4}$  lb. Acid magenta, 1 oz. Cyanole extra, 10 lbs. Glauber's salt, and 2 lbs. sulphuric acid, and working at the boil for one hour, or to shade.

69. **Dark Green on Wool.**—For 100 lbs. weight of goods prepare the dye bath from  $1\frac{3}{4}$  lbs. Fast acid green BN, 1 lb. Orange GG, 10 lbs. Glauber's salt, and 2 lbs. sulphuric acid, working at the boil for one hour.

70. **Turquoise Blue on Wool.**—Prepare the dye bath for 100 lbs. weight of goods from  $\frac{3}{4}$  lb. Cyanole extra, 2 ozs. Fast yellow S, 10 lbs. Glauber's salt, and 2 lbs. sulphuric acid.

71. **Dark Plum on Wool.**—The dye bath is prepared for 100 lbs. weight of goods from 2 lbs. Indigo blue N,  $1\frac{3}{4}$  lbs. Lanafuchsine SB,  $1\frac{1}{2}$  lbs. Acid violet 4RS, 10 lbs. Glauber's salt, and 2 lbs. sulphuric acid.

72. **Dark Claret on Wool.**—Prepare the dye bath for 100 lbs. weight of goods from  $3\frac{1}{4}$  lbs. Lanafuchsine SG, 4 lbs. Orange GG, 5 ozs. Cyanole extra, 10 lbs. Glauber's salt, and 2 lbs. sulphuric acid, working at the boil for one hour.

73. **Dark Cornflower Blue on Wool.**—A dye bath for 100 lbs. weight of goods is prepared from  $1\frac{1}{2}$  lbs. Indigo blue N, 15 ozs. Acid violet 4RS, 10 lbs. Glauber's salt and 2 lbs. sulphuric acid.

**74. Black on Wool.**—Prepare the dye bath for 100 lbs. weight of goods from 6 lbs. Naphthylamine black T,  $\frac{1}{4}$  lb. Tropæoline OO, 10 lbs. Glauber's salt, and 2 lbs. sulphuric acid.

**75. Dark Brown on Wool.**—Prepare the dye bath for 100 lbs. weight of goods from 3 lbs. Tropæoline OO,  $1\frac{1}{4}$  lbs. Lanafuchsine SB,  $1\frac{1}{4}$  lbs. Fast acid green BN, 10 lbs. Glauber's salt, and 2 lbs. sulphuric acid, working at the boil to shade.

**76. Dark Walnut Brown on Wool.**—For 100 lbs. weight of goods the dye bath is made from  $3\frac{1}{2}$  lbs. Tropæoline OO,  $1\frac{1}{4}$  lbs. Naphthol red C,  $1\frac{1}{4}$  lbs. Fast acid green BN, 10 lbs. Glauber's salt, and 2 lbs. sulphuric acid.

**77. Nut Brown on Wool.**—Make the dye bath for 100 lbs. weight of goods from  $2\frac{1}{2}$  lbs. Tropæoline OO,  $1\frac{1}{4}$  lbs. Lanafuchsine SG, 10 ozs. Fast acid green BN, 10 lbs. Glauber's salt, and 2 lbs. sulphuric acid, working at the boil to shade.

**78. Peacock Green on Wool.**—The dye bath is prepared from 3 lbs. Indigo blue N, 1 lb. Fast yellow S,  $\frac{1}{2}$  lb. Orange GG, 10 lbs. Glauber's salt, and 2 lbs. sulphuric acid, these quantities being sufficient for 100 lbs. weight of goods.

**79. Dark Lavender on Wool.**—Prepare the dye bath for 100 lbs. weight of goods from 5 ozs. Cyanole extra, 5 ozs. Lanafuchsine SB, 10 lbs. Glauber's salt, and 2 lbs. sulphuric acid.

**80. Silver Grey on Wool.**—Prepare the dye bath for 100 lbs. weight of goods with 5 ozs. Cyanole extra, 2 ozs. Orange GG,  $\frac{1}{2}$  oz. Azo orseill BB, 10 lbs. Glauber's salt, and 2 lbs. sulphuric acid.

**81. Dark Olive Green on Wool.**—Use in preparing the dye bath  $2\frac{1}{2}$  lbs. Indigo blue N,  $1\frac{1}{2}$  lbs. Tropæoline OO, 10 lbs. Glauber's salt, and 2 lbs. sulphuric acid, these being the quantities for 100 lbs. weight of goods.

**82. Sage Green on Wool.**—The dye bath for 100 lbs. weight of goods is made with  $1\frac{1}{4}$  lbs. Tropæoline OO, 1 lb. Indigo blue N, 10 lbs. Glauber's salt, and 2 lbs. sulphuric acid.

**83. Dark Navy Blue on Wool.**—For 100 lbs. weight of goods the dye bath is made from 6 lbs. Indigo blue SGN, 5 ozs. Orange extra,  $1\frac{1}{4}$  lbs. Formyl violet S4B, 10 lbs. Glauber's salt, and 2 lbs. sulphuric acid, working at the boil for one hour.

**84. Sage on Wool.**—Make the dye bath for 100 lbs. weight

of goods from 1 lb. Orange GG, 6 ozs. Cyanole extra, 10 lbs. Glauber's salt, and 2 lbs. sulphuric acid.

## 7. DYEING MIXED COTTON AND WOOL GOODS.

Many textile fabrics are now made with a cotton warp and wool weft or *vice versa*; these are sold under a variety of names, such as half woollens, unions, &c., and the garment dyer occasionally has them to re-dye; in such an event the best method of procedure is to first cleanse them in soap and water; no attempt should be made to strip the colour from the goods, as any such proceeding would lead to the destruction of the cotton portion of the fabric; hence this class of goods must be either re-dyed in the same colour, or in some darker shade which will cover the original colour; what this new colour may be will largely depend upon the character of the old one, and the dyer must, in deciding what can be done, bring to bear that knowledge which can be gained by experience; the hints which have been given on p. 53 will be found of service in this connection.

The garment dyer will find that he will obtain the best results in dyeing mixed wool and cotton goods by making use of the Direct series of dyes of which Titan yellow, Titan scarlet, Titan brown, Chrysophenine, Chrysamine, Benzopurpurine, Diamine scarlet, are examples. Generally these dyes work on to the two fibres with equal facility, especially if the dye bath contains rather more salt or Glauber's salt than usual; the addition of soap to the dye bath should be avoided, as it tends to prevent the colour going on to the wool, the cotton thereby taking the darkest shade; while if there be any difference between the two fibres, the wool should be dyed darker than the cotton.

For garments made from cloths woven from both cotton and wool, which of late years has come largely into use for cheap dresses and suits of all kinds, the Diamine dyes have been found to be of considerable service, either used alone or with the addition of a wool dye to shade off the wool part of the garment to the colour of the cotton. Blacks can be dyed with Oxydiamine black BM or Union black S, with a little Diamine green B to shade it, and with the addition of a little Naphthylamine black 4B to shade the wool; a simple bath of Glauber's salt suffices. Blues can be dyed with Diamine new blue R or Diamine dark blue B shaded with a wool dye, Formyl violet S4B or WB, Naphthol blue black, or Lanacyl blue. For browns Diamine brown M or Diamine catechine G shaded with one of

the Diamine blacks or Diamine green are very useful. The following wool dyes will be found very useful for working along with the Diamine dyes for the purpose of shading off the wool; as they will dye wool from a neutral bath:—Formyl violets S4B, 6B, and 10B, Lanacyl blues BB and R, Lanacyl navy blue B, Thiocarmine R, Lanacyl violet, Azo red A, Rhodamine B, Croceine AZ, Orange extra, Orange ENZ, Indian yellow, Naphthylamine blacks 4B, 6B, and S.

In mixed wool and cotton goods it is much easier to dye the two fibres in two different colours, and one or two examples of such dyeing will be given; to effect such double dyeing different methods may be followed—either the wool may be dyed first with an acid dyeing colour, such as indigo extract, Scarlet R, Acid Magenta, Acid violet, &c., and then the cotton, after mordanting with tannin and tartar emetic, dyed with some basic colour, like Magenta, Auramine, Thioflavine T, Malachite green, &c. Or the cotton may be dyed first with some Direct colour, such as Titan scarlet, Titan yellow, Diamine black BO, Benzoazurine, &c., which will resist the action of acids, and then the wool dyed with some acid dyeing colours.

1. **Scarlet on Half-Woollens.**—Prepare the dye bath with  $2\frac{1}{2}$  ozs. Titan scarlet CB and 3 lbs. salt, working at the boil to shade.

2. **Chestnut Brown on Half-Woollens.**—Prepare the dye bath with 1 oz. Titan brown O, 1 oz. Titan blue 3B, 3 lbs. salt, and a little acetic acid, working at the boil to shade.

3. **Walnut Brown on Half-Woollens.**—Prepare the dye bath with  $1\frac{1}{2}$  ozs. Titan blue 3B,  $\frac{3}{4}$  oz. Titan brown O,  $\frac{1}{2}$  oz. Titan brown R, 3 lbs. salt, and a little acetic acid, working at the boil to shade.

4. **Plum on Half-Woollens.**—Prepare the dye bath with  $1\frac{1}{2}$  ozs. Titan blue R,  $\frac{1}{2}$  oz. Titan scarlet S, and 3 lbs. salt, working at the boil to shade.

5. **Crimson on Half-Woollens.**—Prepare a dye bath with 3 ozs. Titan red 6B and 3 lbs. salt, working at the boil to shade.

6. **Green on Half-Woollens.**—Prepare a dye bath with alum, indigo extract, and fustic extract, in which the wool can be dyed green in the usual way; then lay down the goods in a bath of 2 ozs. tannin for three hours in the cold, or, at the most, a hand heat; then pass through a bath of tartar emetic to fix the tannin; and dye the cotton green in a new bath with 1 oz. Green

crystals A, and  $\frac{1}{2}$  oz. Auramine. By careful proportioning of the last two dyestuffs various shades of green can be dyed, and so the shade of the wool be matched.

7. **Green on Half-Woollens.**—Dye the wool green from a bath of 1 oz. Acid green S,  $\frac{1}{2}$  oz. Naphthol yellow S, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid, working at the boil to shade; then rinse, and lay down the goods in a bath of tannic acid, fix in tartar emetic, and dye with Green crystals A and Auramine, as in the last recipe.

8. **Black on Half-Woollens.**—Prepare a dye bath with 4 ozs. Nyanza black B, 4 ozs. Columbia black R, and 10 ozs. Glauber's salt, working at the boil to shade.

9. **Black on Half-Woollens.**—Dye the wool by boiling for one hour in a bath containing 10 ozs. Glauber's salt, 2 ozs. sulphuric acid, 4 ozs. Acid black S, and  $\frac{1}{4}$  oz. Acid green; then lay down over night in a bath of 10 ozs. sumach extract, pass through a bath of iron liquor, and dye at the boil with 8 ozs. logwood extract and 2 ozs. fustic extract. The depth of black on the cotton may be increased by repeating the last two operations.

10. **Black on Half-Woollens.**—Dye the wool black as described in the last recipe; then, for the cotton, prepare a new dye bath with 5 ozs. Diamine black RO, 1 oz. Titan yellow, 10 ozs. salt, and 4 ozs. borax, working at the boil to shade.

11. **Grey on Half-Woollens.**—Prepare a bath with 2 ozs. tannin and 2 ozs. logwood; enter the goods at a temperature of about 160° F., and work for 45 minutes, then lift, and enter into a bath of 3 ozs. of copperas, or a bath of iron liquor may be used; work in this bath to the required shade, then lift, rinse, and dry.

12. **Violet Grey on Half-Woollens.**—Prepare a bath from 8 ozs. sumach, heat to 120° F., work for 15 minutes, then allow to steep for 3 hours; lift, pass the articles into a bath of iron liquor of about 2° Tw. strength for ten minutes; then lift, and hang in the air for half an hour. Next prepare a dye bath with  $3\frac{1}{2}$  ozs. alum,  $3\frac{1}{2}$  ozs. tartar, 2 ozs. indigo extract, and  $\frac{1}{4}$  oz. Methyl violet; work at the boil to shade, lift, wash, and dry. A subsequent passage through the iron liquor will deepen the shade.

13. **Terra Cotta Red on Half-Woollens.**—Prepare a bath with 1 lb. cutch; work the goods in this for two hours at about 150° F., then pass into a cold bath of  $\frac{1}{2}$  lb. copperas for half an hour, finally raising the colour by working in a hot bath of  $\frac{1}{4}$  lb. bichromate of potash; lift, wash, and dry.

**14. Drab on Half-Woollens.**—Prepare a bath from  $\frac{1}{2}$  lb. cutch, an old bath will give the best results; work in this for half an hour, then pass into a bath of 2 ozs. potassium bichromate at  $160^{\circ}$  F. for a quarter of an hour, then sadden in a bath of iron liquor of about  $1^{\circ}$  Tw.

**15. Bordeaux on Half-Woollens.**—First dye the wool in a bath of 10 ozs. Glauber's salt, 3 ozs. sulphuric acid, and 3 ozs. Bordeaux S, at the boil for one hour; then lift and rinse well; then lay down in a cold bath of 4 ozs. tannin for 3 hours; fix by passing through a bath containing 3 ozs. tartar emetic, rinse, and dye at a hand heat with 2 ozs. Magenta and  $\frac{1}{2}$  oz. Auramine; if necessary shade with Methyl violet 2R.

**16. Bordeaux on Half-Woollens.**—Lay down the articles over night in a bath of 4 ozs. tannin, next day fix by passing for a quarter of an hour into a bath of 3 ozs. tartar emetic. The dye bath is prepared with 3 ozs. Magenta, 1 oz. Auramine, and 10 ozs. Glauber's salt; heat to about  $120^{\circ}$  F., slowly enter the goods, then slowly raise to the boil, and work to shade.

**17. Dark Brown on Half-Woollens.**—Dye the wool with 4 ozs. Glauber's salt, 4 ozs. alum, 1 oz. sulphuric acid, 2 ozs. Acid brown, and 1 oz. indigo extract; work for one hour at the boil; rinse and pass into a warm bath of  $1\frac{1}{2}$  lbs. cutch and  $3\frac{1}{2}$  ozs. bluestone and steep for three hours; lift and pass through a bath of 3 ozs. bichromate of potash and 2 ozs. alum for fifteen minutes; then dye in a bath containing 4 ozs. camwood, 6 ozs. logwood extract, and 6 ozs. fustic extract, working at the boil to shade.

**18. Violet on Half-Woollens.**—Prepare with tannic acid and tartar emetic as described in receipe 16; then dye with Methyl violet at a hand heat. By using various brands of the violet different shades of violet can be dyed. See remarks on this head under silk dyeing.

**19. Green on Half-Woollens.**—Dye the wool in a bath of  $\frac{1}{2}$  lb. indigo extract, 1 oz. picric acid, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid, working at the boil for one hour; lift, rinse, and prepare with tannic acid as previously described; then dye with Green crystals A and Auramine, as before.

**20. Olive Green on Half-Woollens.**—Prepare a cutch liquor of  $3^{\circ}$  Tw. strong, steep the articles in this over night, then rinse and work for half an hour in a bath of iron liquor at  $4^{\circ}$  Tw.; lift and dye in a fresh bath which contains 3 lbs. fustic,  $1\frac{1}{2}$  ozs. bluestone,  $\frac{3}{4}$  oz. Bismarck brown, and  $\frac{1}{2}$  oz. Green crystals A. Enter the articles while the bath is cold, then raise slowly to the boil, and work to shade.

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21. **Olive on Half-Woollens.**—First dye the wool to shade with Glauber's salt, sulphuric acid, indigo extract, archil, and Fast yellow. Then steep in a cold bath made from 5 ozs. tannic acid for four hours ; fix by passing through a bath of iron liquor ; then dye the cotton to shade in a bath containing Green crystals A, and Bismarck brown, working at a hand heat only, so that the wool shall take up as little colour as possible from this bath.

22. **Brown on Half-Woollens.**—Boil the articles in a bath of 1 oz. bichromate of potash, 1 oz. tartar, and 2 ozs. alum for one and a-half hours ; next pass into a bath of 1 lb. fustic and 1½ ozs. of Brazil wood, working at the boil for one hour ; then steep in a bath of 6 ozs. cutch and 1½ ozs. bluestone for three hours at about 120° F. ; then pass through a hot bath of 1 oz. bichromate of potash, finally dyeing in a new bath with  $\frac{1}{2}$  oz. Bismarck brown at 130° F. to shade.

23. **Black and Green on Half-Woollens.**—Dye the black with Acid black S, by the method given in receipt 9 ; then lay down in a bath of sumach liquor at 2° Tw. for four hours ; then pass into a bath of iron liquor at 2° Tw. for ten minutes ; next dye in a warm bath containing 1 oz. Brilliant green.

24. **Dark Blue on Half-Woollens.**—Dye the wool by boiling in a bath of 3 ozs. Naphthazine blue, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid ; steep in a bath of 4 ozs. sumach extract for four hours, pass through a bath of iron liquor for fifteen minutes, then dye in a warm bath of 2 ozs. Methylene blue B.

25. **Blue on Half-Woollens.**—Dye in a bath containing 2 ozs. Blackley blue, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid ; treat with tannic acid as described above, fix in a bath of nitrate of iron ; then dye in a new bath with New blue or Vacanceine blue at a hand heat.

26. **Crimson and Green on Half-Woollens.**—Dye the wool by boiling in a bath of 2 ozs. Scarlet 3R, 1 oz. Azocarmine, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid, working at the boil for one hour ; rinse, prepare with tannic acid and tartar emetic as described above, and then dye the cotton in a bath of 1 oz. Brilliant green and  $\frac{1}{2}$  oz. Auramine.

27. **Green and Scarlet on Half-Woollens.**—Dye the cotton by boiling in a bath of 3 ozs. Titan scarlet CB, and 10 ozs. salt ; then dye the wool by boiling in a bath of 1 oz. Acid green, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid.

28. **Blue and Yellow on Half-Woollens.**—Dye the cotton by boiling in a bath of 3 ozs. Titan yellow Y, and 10 ozs. salt ;

then dye the wool by boiling in a bath of  $1\frac{1}{2}$  ozs. Acid blue 4S, 10 ozs. Glauber's salt, and 2 ozs. sulphuric acid, working at the boil.

**29. Black on Half-Woollens.**—Prepare a dye bath for 100 lbs. weight of goods with 4 lbs. Union black B,  $1\frac{1}{2}$  lbs. Acid green extra, and 20 lbs. Glauber's salt.

**30. Dark Brown on Half-Woollens.**—The dye bath is prepared for 100 lbs. weight of goods with 1 lb. Diamine orange B, 1 lb. Diamine fast yellow B, 14 ozs. Union black S, 1 lb. Diamine brown M,  $\frac{1}{2}$  lb. Indian yellow C, and 20 lbs. Glauber's salt; work at the boil to shade.

**31. Dark Blue on Half-Woollens.**—Make the dye bath with 4 lbs. Diamine steel blue L, 13 ozs. Diamine fast yellow B, 14 ozs. Thiocarmine R,  $2\frac{1}{4}$  ozs. Indian yellow C, and 20 lbs. Glaubér's salt, these quantities being for 100 lbs. weight of goods.

**32. Drab on Half-Woollens.**—For 100 lbs. weight of goods make a dye bath with  $4\frac{3}{4}$  ozs. Diamine orange B,  $\frac{1}{2}$  oz. Diamine fast yellow A,  $1\frac{1}{4}$  ozs. Union black S,  $\frac{1}{8}$  oz. Naphthol blue black, and 20 lbs. Glauber's salt, the bath being used at the boil to shade.

**33. Nut Brown on Half-Woollens.**—Make the dye bath from  $3\frac{1}{4}$  lbs. Diamine orange B,  $6\frac{1}{2}$  ozs. Union black S,  $1\frac{1}{2}$  ozs. Diamine bordeaux B, 8 ozs. Indian yellow G,  $2\frac{1}{2}$  ozs. Naphthol blue black, and 20 lbs. Glauber's salt, for 100 lbs. weight of goods.

**34. Dark Navy Blue on Half-Woollens.**—For 100 lbs. weight of dresses and garments prepare a dye bath with 2 lbs. Union black S, 2 lbs. Oxydiamine black BM,  $9\frac{1}{2}$  ozs. Naphthol blue black,  $4\frac{3}{4}$  ozs. Formyl violet S4B, and 20 lbs. Glauber's salt, working at the boil to shade.

**35. Dark Slate on Half-Woollens.**—Make the dye bath for 100 lbs. weight of goods from  $\frac{1}{2}$  lb. Diamine orange B,  $6\frac{1}{2}$  ozs. Union black,  $\frac{1}{2}$  oz. Diamine bordeaux B,  $2\frac{1}{2}$  ozs. Azo red A,  $1\frac{1}{2}$  ozs. Naphthol blue black, and 20 lbs. Glauber's salt, working at the boil to shade.

**36. Deep Plum on Half-Woollens.**—The dye bath for 100 lbs. weight of goods is made from  $2\frac{1}{2}$  lbs. Diamine violet N,  $9\frac{1}{2}$  ozs. Union black, 1 lb. Formyl violet S4B, and 20 lbs. Glauber's salt, working at the boil.

**37. Fawn Drab on Half-Woollens.**—Work 100 lbs. weight

of goods in a bath made from  $3\frac{1}{4}$  ozs. Diamine orange B, 1 oz. Union black,  $\frac{1}{4}$  oz. Diamine bordeaux B, 1 oz. Azo red A,  $\frac{1}{4}$  oz. Naphthol blue black, and 20 lbs. Glauber's salt.

Generally the double dyeing of half-woollens may be carried out in the same way as the double dyeing of half-silks, which has been described on p. 78, *et. seq.*

### 8. DYEING OF COTTON GOODS.

The dyeing of cotton dresses and other cotton fabrics forms but a small portion of the work of a general jobbing dyer, most persons thinking a cotton dress scarcely worth the trouble of re-dyeing; while the washing of them is so simple an operation that most persons can, and do, undertake that work themselves.

The introduction of the so-called Direct series of dyes, of which Congo red, Benzopurpurine, Titan yellow, Diamine blue, and Congo brown are examples, has very much altered the methods of cotton dyeing, and has placed at the disposal of the garment dyer greater facilities for the dyeing of cotton fabrics; by their means he can dye a great variety of tints, from the palest pinks and creams to the deepest reds and blacks; the number of dyestuffs which are available are now, although they are but of comparatively recent introduction, so numerous that it is practically impossible in a work like the present to enumerate them all, or to describe the infinite variety of shades which may be dyed with them.

The simplest and most generally applicable process for their application in cotton dyeing is to dye them on to the fabric at the boil in a bath which contains common salt; for, while some will give brighter shades from baths which contain a little soap and soda, and others from baths which contain an alkaline salt, like phosphate of soda or borax, still the salt method is good for them all.

The red dyes of this series include Titan reds, Titan scarlets, Titan pink, the Congo reds, the Benzopurpurines, the Diamine reds and scarlets, the Azopurpurines, with which shades from bright pinks to deep crimson shades can be dyed. The Titan pinks and reds give shades which are fast to acids, and fairly fast to washing; the others are materially changed by acids, even dilute ones, in general becoming blue, the colour being, however, restored on washing with soap and water. On the whole, the garment dyer will do well to use the Titan reds for any cotton dyeing he may have to do, as these have the

advantage of being fast to acids, and are as fast to washing and light as any of the other direct reds.

The yellows are pretty numerous, and comprise Titan yellows, Turmerine, Oxyphenine, Clayton yellow, Chrysamine, Chryso-phenine, Thioflavine S, Diamine Fast yellow, &c. These can all be dyed on to cotton from baths containing salt or phosphate of soda; they give bright shades; those which give more orange shades of yellow (Titan yellow R, Chrysamine) are excellent for dyeing cream shades on lace curtains, &c. In general, the yellows are very fast to light and washing; one or two, as Oxyphenine and Thioflavine S, are fast to alkalies; but most of them are turned scarlet by alkalies, and on being washed with too alkaline a soap are reddened thereby.

The blues of this group are fairly numerous, and comprise Titan blues, Titan Como blues, Benzoazurines, Congo blues, Diamine blues, Columbia blues, &c. They give the best results when dyed in a neutral bath, one containing either salt or Glauber's salt. In general, the blues so dyed are fast to light; many of them resist acids; some are reddened by alkalies; while nearly all of them are fast to soaping and washing.

The blacks comprise Diamine blacks, Benzo blacks, Diazo blacks, &c., they give, in general, blacks of a bluish shade; but, by the addition of a little yellow dyestuff, good full black shades can be obtained. They are usually fast to acids, washing, and soaping, and by their use the garment dyer has at his command ready means of obtaining with ease good blacks. There is one feature of these direct blacks that is very valuable; when, after dyeing, the dyed goods are treated for about a quarter of an hour in an acid solution of nitrite of soda, the colour which is on the fibre becomes diazotised, as it is called; if now the goods are passed into a solution of phenylene diamine, or beta-naphthol, full and fast blacks are developed. These "ingrain" blacks are much faster to light, acids, and soaping than the original blacks.

The brown direct colours, such as Titan browns, Benzo browns, Congo browns, Toluylene browns, Chicago browns, Diamine browns, Cotton browns, are best dyed on to cotton from salt baths. In general, they are not so satisfactory in use as most of the other direct colours, inasmuch as they give shades of a loose character. Some of them, the Diamine browns, Cotton browns, and Diazo browns, can be diazotised and developed up into fast browns. The direct browns dye shades from a fawn red to a deep walnut brown, although the majority dye shades resembling those dyed with Bismarck brown.

The other Direct colours do not call for any general notice. In the recipes which follow will be found many examples of their use. In these recipes will also be found full details for the application of the various dyes named above.

The universal method of applying the Direct Colours in the dyeing of cotton is by preparing a dye bath which contains the particular dyestuff which is being used, and from 15 to 20 per cent. of the weight of the cotton of common salt ; the goods may be entered into the bath while the latter is hot ; but, in any case, the goods are boiled for one hour to one and a-half hours ; they are then lifted, rinsed, and dried. In but few cases is the dye bath exhausted of colour ; in all cases it may be used again and again for further lots of goods ; before adding each lot there is added to the bath sufficient water to make it up to its original volume, from one-tenth to one-sixth the original quantity of salt and about two-thirds of the original quantity of dyestuff. In place of common salt, Glauber's salt may be used. Some of the dyes—*e.g.*, Benzopurpurine, Hessian purple, Azopurpurine—dye best in an alkaline bath, in which case the dye bath contains 10 to 15 per cent. of soda crystals and  $2\frac{1}{2}$  per cent. of soap. Some of the blues—*e.g.*, Benzoazurine, Diamine blue, Congo blue, &c.—dye best in a bath which contains Glauber's salt and soap. The Diamine Colours generally dye best in a bath which contains 15 per cent. of Glauber's salt and 5 per cent. of soda. The yellows, Chrysamine, Chrysophenine, Clayton yellow, and Oxyphenine, dye best in a bath which contains 15 per cent. of phosphate of soda and 3 per cent. of soap.

The cotton dyer may make use of the basic series of coal-tar dyes, which comprises such colours as Magenta, Safranine, Auramine, Victoria blue, Nile blue, Vacanceine blue, Acridine orange, Thioflavine T, Benzoflavine, Brilliant green, Methyl violet, &c. These require the cotton to be mordanted with tannic acid or some other tannin material before it will take the dye. The usual method of dyeing is to first treat the cotton in a bath of 2 to 3 per cent. of the weight of the cotton of tannic acid, immersing it in this bath at a temperature of about  $120^{\circ}$  to  $150^{\circ}$  F, for three to four hours ; some dyers prepare a boiling tannin bath, immerse the cotton in this, and leave it in until the bath is cold or but lukewarm. Next the cotton is wrung or rinsed and then passed into a bath of 2 to  $2\frac{1}{2}$  per cent. of tartar emetic or some other antimony salt ; this bath is used cold and the cotton is treated for about half an hour, after which it is taken out, then rinsed and entered

into the dye bath. It is best to start the dye bath cold, or at a hand heat; then, when all the goods are entered, to raise the heat to 180° or 190° F., and work until the proper shade has been obtained. In cases where dark shades are being dyed sumach may be used in place of tannic acid, while, in dyeing browns, myrabolams, divi divi, cutch, or any other tannin material may be applied. In the dyeing of maroons and dark greens the tannin on the cotton may be fixed by passing through a bath of iron liquor or copperas. Examples of these various plans will be found given in the recipes which follow. The principle which underlies the dyeing of cotton with the basic colours is that the tannin, having a natural affinity for the cotton fibre, becomes fixed thereby; it is still, however, in a rather loose state and much can be washed out of the cotton; so that if such tanned cotton were immersed in a dye bath some of the tannin would get washed away from the cotton, resulting in the production of weak shades and other defects. By subsequently immersing the tanned cotton in a bath containing an antimony, iron, or some other metallic salt, the tannin forms an insoluble tannate of the metal, which is firmly fixed on the fibre, and, therefore, cannot be washed out of the fibre afterwards. When the tanned cotton is immersed in the dye bath, the tannin and the dye combine together to form an insoluble coloured body, a colour lake it is called, which is fixed on the fibre by the double affinity of the tannin—on the one hand for the cotton and, on the other, for the antimony or other metal which has been used to fix the tannin. When light tints are being dyed with the basic colours it is important to use the best tannin or tannic acid which can be bought and tartar emetic. Sumach and other tannin matters can only be used for dyeing dark shades.

The cotton dyer of former times made extensive use of the natural dyestuffs, such as cutch, gambier, logwood, Brazil wood, fustic, quercitron, &c., in the dyeing of his goods; these are still available for the modern dyer, but, nowadays, are by no means so much used as formerly, the introduction of the groups of coal-tar colours just briefly noticed having placed in the hands of dyers easier and more reliable means of dyeing than what the natural dyestuffs afford. The method commonly followed by the garment dyer in working with the natural dyes is the one known as the *stuffing and saddening method*. The goods are first steeped for a longer or shorter time in a decoction of the dyestuff or dyestuffs; then they are passed into a bath containing some metallic salt, such as bichromate of potash, iron sulphate, copper

sulphate, &c., by which means the colour is developed and fixed upon the fibre. This two-bath method is the best and most economical, and gives the fastest shades; but another plan is sometimes followed, and that is to mix the dyestuff and the mordant together in one bath; this method, however, results in a loss of colour owing to the precipitation of some of the dye to the bottom of the vat, while the colour thus dyed has a greater tendency to rub off. In the recipes given below the use of the natural dyestuffs will be found described in detail.

1. **Cream on Cotton Curtains or Dresses.**—Pleasant shades of cream can be dyed on cotton in a bath containing a little borax and a small quantity of either Titan yellow R, Toluylene orange G, or Chrysamine R. Use as little of the dyestuff as possible.

2. **Salmon on Cotton Fabrics.**—Prepare a dye bath with  $\frac{1}{4}$  oz. Titan brown O and 10 ozs. common salt, working at the boil for one hour. This gives a brownish shade of salmon.

3. **Salmon on Cotton Goods.**—Use  $\frac{1}{4}$  oz. Salmon red and 10 ozs. phosphate of soda. A good bright shade of salmon of a reddish hue is obtained by following this recipe.

4. **Pink on Cotton.**—A fine pink is dyed in a bath containing 1 oz. Titan pink 3B, and 10 ozs. common salt, working at the boil to shade. This pink is fast to washing, and, though it will stand exposure to light fairly well, yet is not quite fast.

5. **Pink on Cotton.**—Make a dye bath with  $\frac{1}{2}$  oz. Erika B, 1 oz. soap, and 10 ozs. common salt, working at the boil to shade. This yields a very fine fast pink.

6. **Orange on Cotton.**—Prepare the dye bath with 3 ozs. Titan orange and 20 ozs. salt, working at the boil to shade.

7. **Navy Blue on Cotton.**—Prepare a dye bath with 3 ozs. Titan navy R and 15 ozs. common salt, working at the boil for one hour.

8. **Navy Blue on Cotton.**—The dye bath is made with 3 ozs. Benzoazurine R, 2 ozs. soap, and 10 ozs. Glauber's salt, working at the boil for one hour.

9. **Yellow on Cotton.**—Prepare a dye bath with 2 ozs. Chrysophenine, 1 oz. soap, and 10 ozs. phosphate of soda, working at the boil for one hour.

10. **Yellow on Cotton.**—Prepare the dye bath with 2 ozs. Titan yellow Y, and 15 ozs. salt, working at the boil.

11. **Yellow on Cotton.**—First mordant the cotton by steeping in a bath of 3 ozs. tannic acid at a temperature of about 180° F. for four hours; then lift, rinse, and pass into a cold bath of 2 ozs. tartar emetic for half an hour; after rinsing, dye in a bath at from 170° to 180° F., which contains 1 oz. Auramine II, or Canary for a chrome yellow shade. If a lemon or greenish tone yellow is wanted, substitute Auramine G, Canary GG, or Thioflavine T.

12. **Yellow on Cotton.**—Prepare the dye bath with 1½ ozs. Oxyphenine and 15 ozs. salt, working at the boil for one hour.

13. **Buff on Cotton.**—A very fast shade is dyed by the following process:—Prepare a bath with 2 lbs. copperas at a hand heat; in this work the goods for about half an hour; then lift and pass into lime water for a quarter of an hour; then hang for two hours, or until dry. If the shade of buff be not deep enough repeat the operations.

14. **Scarlet on Cotton.**—Mordant the cotton as described in recipe No. 11; then dye in a new bath which contains 1 oz. Safranine Prima and ½ oz. Auramine II. By varying the proportions of the Safranine and the Auramine, various shades of scarlet can be obtained, from bluish to yellowish in hue. Auramine G will give brighter and yellower shades than Auramine II.

15. **Maroon on Cotton.**—Prepare a bath with 2 lbs. sumach, and work the goods in this for one hour at about 170° F.; then rinse lightly and pass into a bath of 1 pint of iron liquor for half an hour; finally, dye in a fresh bath at about 180° F. with 1 oz. Magenta B.

16. **Peacock Blue on Cotton.**—First treat in a bath of sumach as described in the last recipe; if deep shades are desired, it is best to allow the goods to steep in the bath over night. Next day pass into a bath containing 4 ozs. copperas and 4 ozs. tin crystals. Next pass into a fresh dye bath containing 2 ozs. Brilliant green, ½ oz. Methyl violet B, and 6 ozs. logwood, working at about 180° F. to shade.

17. **Deep Blue on Cotton.**—Mordant the cotton goods by passing through baths of sumach and iron liquor as described in previous recipes; then dye in a bath containing either New Blue or Vacanceine blue.

18. **Bright Blue on Cotton.**—Mordant the cotton by working in a bath of 3 ozs. tannic acid at 180° F. for two to

three hours; dye in a fresh bath containing 2 ozs. New Methylene blue N, at 180° F. to shade; then rinse and dry. In place of the dyestuff just named there may be used New Victoria blue, Nile blue, Capri blue, or Cresyl Fast blue, all of which give bright blue shades of various tones.

19. **Navy Blue on Cotton.**—Mordant with tannic acid and tartar emetic as in the last recipe, and dye with New blue red shade.

20. **Black on Cotton.**—Steep in a bath made from 12 ozs. cutch and 1 oz. bluestone for five hours, or overnight, the goods being entered at a temperature of about 150° F. Next work for fifteen minutes in a bath of 1 oz. bichromate of potash; lift, rinse, and dye in a new bath containing 2 lbs. logwood and  $\frac{1}{2}$  lb. fustic, working for forty-five minutes at 180° F.; then lift, and add 4 ozs. copperas, re-enter the goods and work for two hours longer without further heating.

21. **Black on Cotton.**—Prepare a dye bath with 5 ozs. Diamine black BO,  $\frac{1}{2}$  oz. Titan yellow R, 15 ozs. Glauber's salt, and 1 oz. soap; work the goods in this at the boil for one hour; then lift, rinse, pass into a cold bath made from 2 ozs. nitrite of soda and 3 ozs. hydrochloric acid, and work for fifteen minutes; again lift and pass into a solution of 2 ozs. phenylene diamine in dilute hydrochloric acid and work for twenty minutes; then lift, rinse well, and dry. This black is a very fast full black, and has the advantage over logwood blacks of leaving the goods with a soft feeling.

22. **Black on Cotton.**—Prepare a decoction of 1 lb. sumach and steep the goods in this for six hours, or overnight; then pass into a bath of iron liquor at 2° Tw. for half an hour. Next prepare a bath with 4 ozs. Diamine black RO,  $\frac{1}{2}$  oz. Turmerine, 10 ozs. Glauber's salts, and 1 oz. soap; work at the boil for one hour. In place of the black just named there may be used Benzo black S, or Fast cotton black, or Oxydiamine black N.

23. **Black on Cotton.**—Prepare a bath from 1 lb. logwood, 6 ozs. fustic, and  $\frac{1}{2}$  lb. sumach; heat to 150° F., enter the goods, and work for three hours at that temperature; then pass into a bath of iron liquor at 4° Tw. for three-quarters to one hour; next hang in the air for one hour to develop the black. Should the shade not come up deep enough, work the goods again in the old baths until they have become dyed a good black. Copperas may be used in the place of the iron liquor, but it does not give as good a black.

24. Aniline Black on Cotton.—Aniline black, when well dyed, is one of the best and fastest blacks known; but, at the same time, it is the most difficult to dye successfully; when not properly developed it has a most troublesome tendency to turn green by exposure to air and wear, especially in the atmosphere of towns. It is a black which cannot be recommended to the garment dyer, and he will be well advised to leave it alone. The following plan gives a good black. Prepare a bath with 40 gallons of water, 2 lbs. aniline salt, and  $\frac{1}{4}$  lb. sulphuric acid; work the goods in this for an hour, then pass into a bath containing 1 lb. bichromate of potash,  $\frac{1}{2}$  pint nitrate of iron, and  $\frac{1}{2}$  lb. sulphuric acid; work for half an hour, then lift, wash, and dry. Should the black so obtained not be deep enough, repeat the operations. It is very important that the final washing be thoroughly done, so that all traces of free acid are washed out; it has been observed that aniline black greens quicker when free acid is present than when it is absent. Passing through a weak soda bath is a good thing; it has, however, a tendency to blue the shade of the black a little. The aniline bath is not exhausted, but may be used again for another lot of cotton goods when about half the quantity of aniline salt has been added. The number of recipes which have been given from time to time for the production of aniline black is large and varied, but it will serve no good purpose to give any other than the one given above.

Blacks may be dyed on to cotton by other processes, but those already given will be found by garment dyers to be quite sufficient for all practical purposes. The method of dyeing described in recipe No. 21 will be found to be perhaps the most convenient to use and to give the most satisfactory results.

25. Brown on Cotton.—A yellowish tone brown is obtained by the following process:—Prepare a bath from 6 ozs. cutch and  $1\frac{1}{2}$  ozs. bluestone; in this steep the goods for four hours at a temperature of  $140^{\circ}$  F. Next pass into a warm bath of  $1\frac{1}{2}$  ozs. bichromate of potash, working in this for half an hour; then pass into a dye bath containing a  $\frac{1}{4}$  oz. Bismarck brown Y at about  $170^{\circ}$  F. for half an hour.

26. Bright Red Brown on Cotton.—Proceed as in the above recipe, but in the final dye bath use  $\frac{3}{4}$  oz. Bismarck brown R.

27. Walnut Brown on Cotton.—Prepare a dye bath with  $1\frac{1}{2}$  ozs. Titan brown Y,  $1\frac{1}{2}$  ozs. Titan blue 3B, and 20 ozs. salt, working at the boil for one hour.

28. Walnut Brown on Cotton.—Prepare a bath with 6 ozs.

Benzo brown NB,  $\frac{3}{4}$  oz. Benzoazurine R, and 20 ozs. salt, working at the boil for one hour.

29. **Dark Brown on Cotton.**—Prepare a bath from 1 lb. sumach; in this, steep the cotton for five to six hours; pass into a bath of iron liquor at about 2° Twaddell for one and a-half to two hours; then rinse and re-enter into the sumach bath for one hour, and, finally, dye in a new bath with 1 oz. Bismarck brown R.

30. **Cherry Brown on Cotton.**—Steep for four to five hours in a bath made from  $\frac{3}{4}$  lb. cutch and  $1\frac{1}{4}$  ozs. bluestone at a hand heat; then pass into a warm bath containing 1 oz. bichromate of potash, working in this for fifteen to twenty minutes; then rinse, pass into a cold bath of  $\frac{1}{2}$  lb. alum for half an hour, and, finally, dye in a bath at 170° F. containing  $\frac{1}{2}$  lb. Brazil wood,  $\frac{1}{4}$  lb. logwood, and  $\frac{1}{2}$  oz. Bismarck brown to shade.

31. **Brown on Cotton.**—A very favourite method of dyeing browns is the following:—Prepare a bath from 4 lbs. sumach, steep the goods in this for six to eight hours or overnight, pass into a hand warm bath of iron liquor at 4° Twaddell for two hours, then dye in a bath containing 2 ozs. Bismarck brown Y and  $\frac{1}{2}$  lb. logwood, at about 180° F.

32. **Brown on Cotton.**—Prepare a dye bath with 4 ozs. Cotton brown N and 20 ozs. salt; in this, dye the cotton for an hour at the boil; lift, wash, and pass into a cold bath of 2 ozs. sodium nitrite and 3 ozs. hydrochloric acid for twenty minutes; then lift and pass into a bath made from 3 ozs. phenylene diamine dissolved in dilute hydrochloric acid, this bath being used cold, and the goods worked in it for half an hour. If Diamine Cutch, or Diamine brown M, or Diamine brown V be used in place of the Cotton brown N, other shades of brown may be obtained. These diazotising processes of dyeing are quite a recent introduction into the art of dyeing; they are well worth the attention of garment dyers for dyeing cotton goods; they give fast shades, leave the cotton soft and supple, and are not difficult; the points to pay most attention to are obtaining a good full bottom with the dyestuff; using the sodium nitrite bath, in which the diazotising takes place, perfectly cold, the colder the better; to pass the goods immediately from the diazotising bath into the final bath in which the new colour is developed, rinsing, however, between the two baths; do not expose the goods after being taken out of the sodium nitrite bath to a strong light. In the two recipes which have been given above, Nos. 21 and 32, phenylene diamine has been given

as a developer ; besides this body others may be used resulting in the production of other shades of blue, black, or brown, according to the dyestuff or the developer which is used. For fuller details as to dyestuffs which are available for use in this method of dyeing, the various developers which may be used and the colours they give, reference may be made to the pages of *The Dyer and Calico Printer*. Neither the dye bath, the diazotising bath, nor the developing bath are exhausted of colour or material; they may, therefore, be kept as standing baths, and only require the addition of about half the quantities of material specified in the recipes for each successive lot of cotton goods which may be dyed in them.

33. **Sea Green on Cotton.**—Prepare a dye bath with a  $\frac{1}{4}$  oz. Columbia green, 15 ozs. Glauber's salt, and  $1\frac{1}{2}$  ozs. soap ; work the goods in this at the boil for an hour.

34. **Russia Green on Cotton.**—Prepare a dye bath with 4 ozs. Columbia green, 15 ozs. Glauber's salt, and  $1\frac{1}{2}$  ozs. soap, working at the boil for an hour.

35. **Sea Green on Cotton.**—First mordant the cotton with tannic acid and tartar emetic, as described above ; then dye at about  $180^{\circ}$  F. in a bath which contains  $\frac{3}{4}$  oz. Diazine green.

36. **Green on cotton.**—First mordant the cotton goods with tannic acid and tartar emetic ; then dye in a new bath with 1 oz. Brilliant green and  $\frac{1}{4}$  oz. Auramine II. Besides Brilliant green there may be used Malachite green and other aniline greens without materially modifying the shade. In place of Auramine, Benzoflavine, or Thioflavine T may be used as the toning colour. By varying the proportions of the two dyes a great variety of shades of green, from a very yellowish to a very bluish green, may be obtained ; many recipes for the production of greens of various hues might be given, involving the use of the two dyes named above ; it is thought, however, that the dyer will find the above hints as to the use of the dyes quite sufficient for all practical purposes.

37. **Deep Green on Cotton.**—First mordant the cotton by steeping in a bath of sumach liquor over night ; then fix, by passing through a bath of iron liquor ; finally, dye in a new bath with 1 oz. Brilliant green.

38. **Olive Green on Cotton.**—First mordant with tannic acid and tartar emetic as usual ; then dye in a new bath containing 1 oz. Brilliant green and 1 oz. Bismarck brown.

39. **Deep Olive Green on Cotton.**—Mordant the cotton

with sumach and iron liquor, as described above; then dye in a new bath with 1 oz. Brilliant green and 1 oz. Bismarck brown. The stronger the sumach bath, the deeper will the resulting colour be; while, by adding a little Auramine to the dye bath, the shade will be brightened.

40. **Bronze Green on Cotton.**—Mordant with sumach and iron as before; then dye in a bath of 1 oz. Brilliant green,  $1\frac{1}{2}$  ozs. Bismarck brown, 4 ozs. fustic extract, and  $1\frac{1}{2}$  ozs. blue-stone, working at about  $180^{\circ}$  F. for one and a-half hours; then lift, wash, and dry.

41. **Violet on Cotton Goods.**—Mordant with tannic acid and tartar emetic; then dye in a bath with 1 oz. Methyl violet, working at a hand heat. By using various brands of the violet dye, a great variety of violet shades can be dyed on cotton (see p. 74).

42. **Dark Violet on Cotton.**—Mordant the cotton goods with sumach and iron liquor; then dye in a new bath at about  $180^{\circ}$  F. with 1 oz. Methyl violet 2B.

43. **Puce on Cotton.**—Mordant with sumach and iron liquor; then dye in a new bath with 1 oz. Methyl violet 2R.

44. **Puce on Cotton.**—Prepare the dye bath with 3 ozs. Diamine violet V, 15 ozs. Glauber's salt, and 3 ozs. soap, working at the boil for one hour. Congo Corinth may also be used to produce puce shades in a similar way.

45. **Lilac on Cotton** can be got by mordanting with tannic acid and tartar emetic, and then dyeing with a little Methyl violet R; if too red, tone by adding a little Methyl violet 3B.

46. **Grey on Cotton.**—A very fast grey can be got by boiling for one hour in a bath containing 2 ozs. Sterosine grey and 15 ozs. salt. By using more or less of the dyestuff various shades of grey can be obtained, while, by adding a little Titan scarlet CB, Titan blue R, or Titan yellow Y, a variety of different tints can be readily produced.

## 9. LINEN GOODS.

Linen can be treated in dyeing by precisely the same methods as cotton, from which it differs but little in its dyeing properties; if anything, it takes the basic dyes rather more easily. Care must be taken to see that the goods are quite clean and free from grease.

## 10. JUTE GOODS.

The garment dyer rarely comes across these ; should he do so, he can employ the same recipes as for cotton ; in dyeing bright shades with the basic coal-tar colours it is not necessary to mordant the jute with tannic acid or tartar emetic. Reference may be made to *The Dyer and Calico Printer* for 1894-95 for much information on jute dyeing.

## 11. WOOL-SILK (GLORIA-SILK) GOODS.

These goods have come largely into use of late, and are woven from both wool and silk in either plain cloths or fancy fabrics with various designs. They are dyed with acid dyes much after the manner of ordinary wool or silk fabrics, and the recipes given under those headings. In *The Dyer and Calico Printer* for October, 1900, will be found a very useful article on this subject.

## CHAPTER IV.

## BLEACHING OF TEXTILE FIBRES.

THE garment dyer may occasionally have goods sent to him which are to be made white or which require bleaching ; some instructions as to methods of procedure will, therefore, be acceptable. Generally speaking, all vegetable fibres may be treated in the same way ; cotton is the easiest to bleach, then comes linen (which fibre requires to be treated much more often and with stronger liquors than does cotton), while jute is more difficult to deal with than either cotton or linen. Other vegetable fibres are rarely met with. Wool and silk are the only two animal fibres which the garment or job dyer is likely to meet ; these may be treated much in the same manner. The chief agent employed in the bleaching of vegetable fibres is chloride of lime (bleaching powder) ; this, however, cannot be used on animal fibres, on account of the disintegrating effect it has ; for these, either peroxide of hydrogen, or peroxide of sodium, or sulphurous acid are available.

## BLEACHING OF VEGETABLE FIBRES.

For the purpose of bleaching cotton, linen, jute, or other vegetable fibres, the following process is available ; cotton is the easiest to bleach, and good results will be obtained if the directions given are followed out ; linen and jute are much more troublesome to deal with, and it may be found necessary to repeat the operations before a satisfactory white is obtained.

1. Prepare a liquor from 2 lbs. caustic soda and 3 lbs. soap for 100 lbs. of goods, using from 120 to 150 gallons of water ; in this boil the goods for two to three hours, turning them over at intervals and always taking care that the goods are well immersed in the liquor ; then take them out and rinse them thoroughly with water. It is important that the caustic soda be thoroughly dissolved, and only a perfectly clear solution used, or, otherwise, damage to the goods may result. So long as the goods are well below the surface of the boiling liquor no

damage will result; but, should any portions project above the surface, then such portions are liable to become tendered.

2. **Bleaching.**—Prepare a perfectly clear solution of bleaching powder of a strength of  $1\frac{1}{2}$ ° Tw., stronger liquors are not desirable or necessary. This liquor is used cold; warm liquors, although quicker in action have, however, too great a tendency to tender the fibre. In this bleaching liquor immerse the goods for about one hour, then lift them out, wring out the surplus liquor and lay them on one side for three hours. Very great care must be taken that no particles of undissolved bleaching powder are allowed to remain in the liquor, or otherwise these getting on to the goods will cause holes to be produced in them wherever they fix themselves.

Next, after having been passed through the bleaching liquor and allowed to lie, the goods are passed into a weak bath of hydrochloric acid, of about 1° Tw., being turned in this for about ten minutes; after which they are well washed in clean water, dried, and finished. It is important that the washing be thoroughly done, or otherwise any acid or chlorine left in the goods will surely lead to their destruction.

**BLEACHING OF SILK.**—The following process, depending upon the action of peroxide of hydrogen, will be found the best and safest process for the garment dyer to apply to silk goods. The quantities named below are adapted to be used for 10 lbs. of silk; for smaller quantities proportionately less must be used. Make a bath with 46 gallons of water, 2 gallons of 10 volume peroxide of hydrogen, and sufficient liquor ammonia to make the bath faintly alkaline. Into this bath the silk is placed and allowed to remain for twelve hours, being turned over from time to time; then the bath is heated to 120° F. for two to three hours, when, as a rule, the silk will have become of a good white colour; if not white enough, the process may be repeated in the same bath, adding perhaps a little more peroxide of hydrogen to strengthen it. The addition of the alkali makes the bath more stable and, therefore, rather more economical in use.

It is not necessary to add anything to this bath, although some users do so, adding such bodies as silicate of soda, phosphate of soda, &c.

Silk may also be bleached by exposing it to the fumes of sulphurous acid gas evolved on burning sulphur, but this method is an inconvenient one unless some place has been constructed specially for its use; therefore, garment dyers generally avoid using it. The sulphur method of bleaching here hinted at has one defect that may be mentioned—viz., the white ob-

tained by it is not a permanent one, the original colour being restored on the first washing of the goods.

A more modern process of silk bleaching is by the use of bisulphite of soda. To prepare the bleaching liquor  $6\frac{1}{2}$  gallons of the ordinary commercial liquid bisulphite of soda is poured over 12 lbs. of zinc dust which has been previously mixed with water into a thin paste ; after thorough mixing, the mass is allowed to stand for twelve hours in a cool place. By the interaction of the bisulphite of soda and the zinc, hydrosulphite of soda is formed along with the sulphites of soda and zinc ; these latter bodies crystallise out ; they are separated from the liquor as far as possible. Care must be taken not to expose the liquor too much to the air or to agitate it too much, or oxidation will set in and it loses its bleaching powers. To use this liquid as a bleaching agent, it is mixed with an equal volume of water ; the silk, which has been previously scoured to free it from grease, is then placed in and allowed to remain for six hours ; after which it is taken out, drained, washed, and dried. If the colour is not quite white enough the operation may be repeated.

If, after the silk has been bleached in the manner just described, it is passed into a weak alkaline bath of peroxide of hydrogen, the effect is to increase the whiteness and to make the bleach more permanent by destroying the sulphurous acid which may linger in the fabric, and converting it into sulphuric acid, which is washed away in the subsequent cleansing operations.

It may be added here that sulphurous acid bleaches by entering into combination with the colouring matter present in the silk and forming with it a colourless compound ; thus the colouring matter is not actually destroyed, as is the case when bleaching is effected by oxidising agents, such as chlorine or peroxide of hydrogen or peroxide of sodium, but is left in the fabric in a latent condition ; if the sulphurous acid present with it is neutralised then the original colouring matter again exerts itself and shows that it is still present in the fabric. This explains how it is that when wool or silk articles are bleached by the sulphur processes the colour comes back again on washing. By subsequently destroying the sulphurous acid in the manner indicated above, the original colouring matter is destroyed and so the bleach is rendered a permanent one.

Recently, a new bleaching agent has been introduced, which will find applications in the bleaching of silk, wool, and other animal fibres. This is the peroxide of sodium of the Aluminium

Metal Co., of Oldbury, near Birmingham. This body occurs in the form of a greyish-white powder, having a composition approximating to the formula  $\text{Na}_2\text{O}_2$ . When thrown on to water it dissolves with great energy; generally a hissing sound is produced and considerable heat is developed; the solution has strongly alkaline properties. When an acid is added to the solution, a neutral sodium salt is obtained along with a solution of hydrogen peroxide; this solution has strong bleaching properties. Owing to the strongly alkaline character of the solution of sodium peroxide it cannot well be used in bleaching silk; but, by taking advantage of the fact that by adding magnesium sulphate to the solution, an action is set up which results in the formation of insoluble magnesium hydroxide, sodium sulphate, and a neutral solution of peroxide of hydrogen, a bleaching bath for silk may be made. The details of the process are as follows:—3 lbs. of Epsom salts (crystallised magnesium sulphate) are dissolved in 20 gallons of water; into the solution is thrown, in small quantities at a time, 1 lb. of sodium peroxide; when all is added, the bath so made is heated to 180° F., the silk entered and turned over for three-quarters to one hour; then the bath is brought to the boil and maintained at that heat for one to one and a-half hours; after which the silk is taken out of the bath, and pressed into a weak sulphuric acid bath, then well rinsed and dried. 1 lb. of sodium peroxide will bleach from 10 to 12 times its weight of silk.

The advantages of sodium peroxide over hydrogen peroxide are that being in a powder form it is much more convenient to handle; it is more stable and can, therefore, be kept longer before it loses its bleaching properties; still, on keeping, it gradually undergoes decomposition into sodium carbonate, caustic soda, and oxygen, the last being lost. Great care is needed in keeping and using it; all contact with wood, paper, or other organic matter must be avoided; otherwise it is liable to set these into combustion with possibly disastrous results. In mixing with water, only small quantities should be added at a time, or great heat is evolved, which causes evolution of oxygen and loss of bleaching power.

Generally, even with the best processes of bleaching, the silk still remains of a faint cream colour; this may be overcome and a good white tint imparted to the silk by the process of tinting with indigo extract, Methyl violet, or Methylene blue. The process consists in immersing the silk in a weak bath of any of these dyestuffs, wringing out and drying. Care must be taken not to use too much of the dyestuff or the silk will become of a

blue or violet tint, instead of a white hue. Generally, Methyl violet will be found to give the best results.

**BLEACHING OF WOOL.**—Wool may be bleached by similar processes to those used for silk.

*Bleaching with Sulphurous Acid.*—Sulphurous acid in a liquid form may now be purchased in glass syphons or copper drums; from this a strong solution may be prepared by passing the gas obtained on opening the valve of the syphon or drum into cold water. By immersing the wool to be bleached in this solution for twenty-four hours, then washing and drying, a fair white can be obtained.

As sulphurous acid is a somewhat unpleasant body to work with, it may be replaced with bisulphite of soda. A solution of this substance at 32° Tw. is prepared and the wool immersed in it for twelve to fifteen hours, then wrung out and passed into a weak bath of sulphuric acid at 6° Tw. This process is usually fairly effective.

Wool may also be bleached with peroxide of hydrogen or peroxide of sodium by the methods detailed on pp. 116 and 118.

The bleach obtained by sulphurous acid is not a permanent one, for the reasons stated when dealing with the corresponding method of bleaching silk; exposure to air, or washing with soap or soda, restores the original colour. The bleach obtained by means of peroxide of hydrogen or peroxide of sodium is permanent.

## CHAPTER V.

## FINISHING CLEANED OR DYED FABRICS.

WHEN ladies' dresses and garments, curtains, and other textile fabrics have passed through the hands of the dyer and cleaner they are by no means finished and in a condition to be sent out to the customer; they have in general a rough looking, crumpled appearance; and to make them look well and show better the labour which has been expended on them, they must pass through a finishing course of operations, the nature of which depends very largely upon the character of the materials or fabrics which are being dealt with. It must be obvious that what will suit a velvet will not answer for a lace curtain, and that what will do for the latter fabric will not do for a ladies' dress or a damask curtain.

As the articles leave the dyeing or cleansing operations they are more or less wet; this moisture must be got rid of; the oldest, most effectual, and simplest plan, where small lots are being dealt with, is to wring them out by hand, when the great bulk of the moisture can be squeezed out of them; the rest must be got rid of by hanging them in an open space or room to dry. Simple as it is, there is a right and a wrong way of doing it; the manner in which the articles should be wrung depends upon their nature; thus, velvets and all pile fabrics of a similar nature should not be twisted, but should have their surplus water pressed out of them by a steady pressure between the hands; lace curtains should be wrung in the direction of their length, so that they are stretched as much as possible; the same holds good as regards knitted fabrics.

Better than hand wringing is that by means of the familiar roller wringing machine, which may be applied to nearly all fabrics; velvets, velveteens, plush, and all fabrics having a pile must not be wrung by this machine. The great thing in wringing is the folding the articles the right way, so that they are drawn into the machine in the direction of their length, while it creases them as little as possible.

The best possible way of wringing, or rather extracting the water out of wet textile fabrics, is by means of the hydro-extractor. This machine may be used for wringing out all

kinds of textile fabrics without doing them any damage. It is made in several forms and by many makers. The principle is, however, the same in all the machines; an inner perforated cage revolving at great speed, into which the goods are placed. By the centrifugal action set up on the revolution of the machine the water in the articles placed in the inner cage is driven to the circumference of the cage, and finds its way through the perforations of the latter, and is conducted away by the outer casing. In hydro-extractors, practically no pressure is brought upon the goods, the pile of such fabrics as velvets and pluses is not injured in any way, so that they are in a fit condition for after treatment. As regards the amount of water which these hydro-extractors can get from the goods they are far superior to the ordinary wringing machine, and leave the goods, as a rule, in such a condition that the after processes of finishing may be proceeded with at once; while the goods passed through a wringing machine are generally in so wet a condition that they require more or less drying before being finished.

Of hydro-extractors there are many makers and many types, some are made with the driving arrangements underneath; these are known as under-driven hydros; others, again, have all the working parts at the top of the machine, these are known as over-driven hydros. In some respects the under-driven type of hydros has advantages over the over-driven type, inasmuch as the driving arrangements are not in the way of the workmen in filling the extractor and emptying it. On the other hand, with the over-driven type, it is possible to secure the outer cage more firmly to the floor, thereby giving greater steadiness to the whole machine. Again, large hydros are often made what are called self-contained—that is, the working parts are in direct connection with a small donkey engine; this form is excellent for large hydros; it is economical and convenient, as the speed may be regulated with the greatest ease, a factor of no little importance in some cases. With small hydros it is not convenient or, in many cases, economical to drive them separately by donkey engines; in such cases they must be driven by belts from the general shafting of the works.

Figs. 19 to 28 show several forms of hydros, all of which are in practical use.

Fig. 19 shows a form of hydro driven by hand very convenient for use in small works, where other power is not available, or but small lots of goods are to be dealt with. It belongs to the under-driven type. The surface water flows out of an outflow pipe placed at the bottom of the outer case into a tub placed under the hydro to receive it.

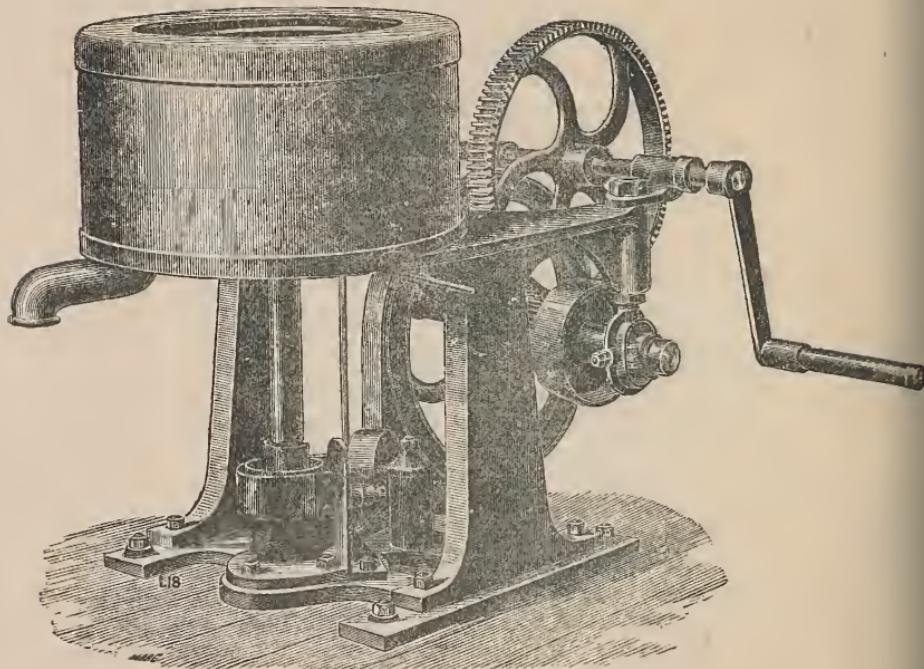


Fig. 19.—Hand-driven hydro-extractor.

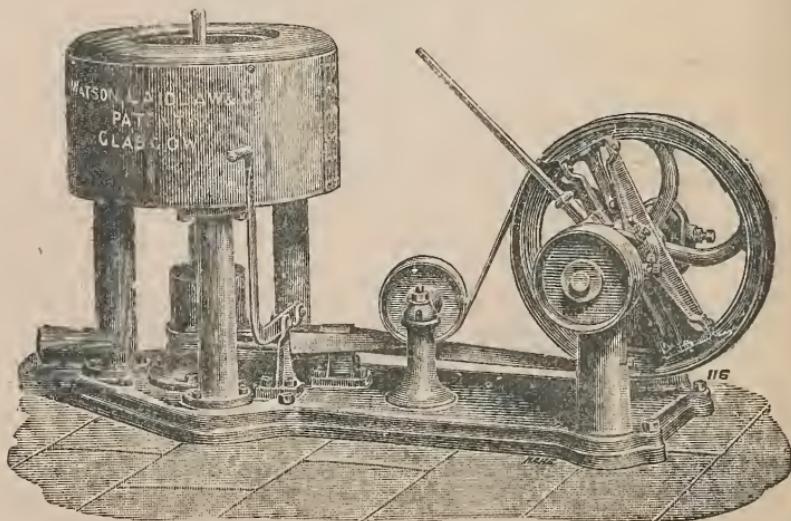


Fig. 20.—Under-driven hydro-extractor.

Figs. 20 and 21 are well-known forms; they are of the under-driven type, worked by a belt from a main shaft and fitted with multiplying gear, by means of which a high rate of speed can be attained. Fig. 21 shows the construction of the machine very clearly. The hydros shown in Figs. 20 and 21 are constructed in such a manner that the cage is self-balancing when in motion; in other words, it is not needful in filling to be so careful with this machine to evenly balance the goods in the cage as it is with some other forms. Fig. 21 is constructed to suit those works where it is desirable to have the driving power in one room while the hydro is in another. The starting handle being placed close to the machine. The long belt facilitating this.

Figs. 22 and 23 show a type of hydro adapted for large works, these are self-contained—that is, they are separately provided

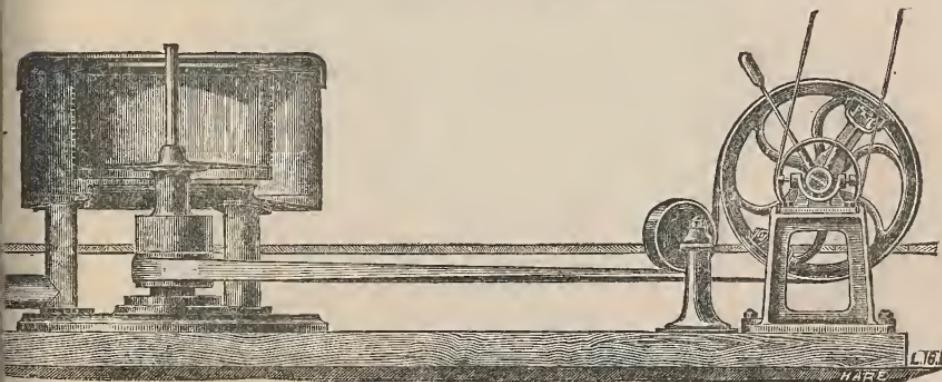


Fig. 21.—Under-driven hydro-extractor.

with engines to drive them. They are overhead hydros as will be seen, while the construction is such that the cage possesses a self-balancing power which is of great importance as adding to the life of the machine. The engines do not work directly upon the basket, but a multiplying gear is provided which by enabling the engine to run more slowly reduces its wear and tear very much. Fig. 22 is a sectional view and shows very clearly the construction of a hydro-extractor. Fig. 23 shows a perspective view of the machine. Both these last two forms are made in different sizes to suit the requirements of the users.

Fig. 24 shows a type of machine which is very much used in laundry works; it is driven by a belt and belongs, as will be seen, to the under-driven type. In some respects it is simpler

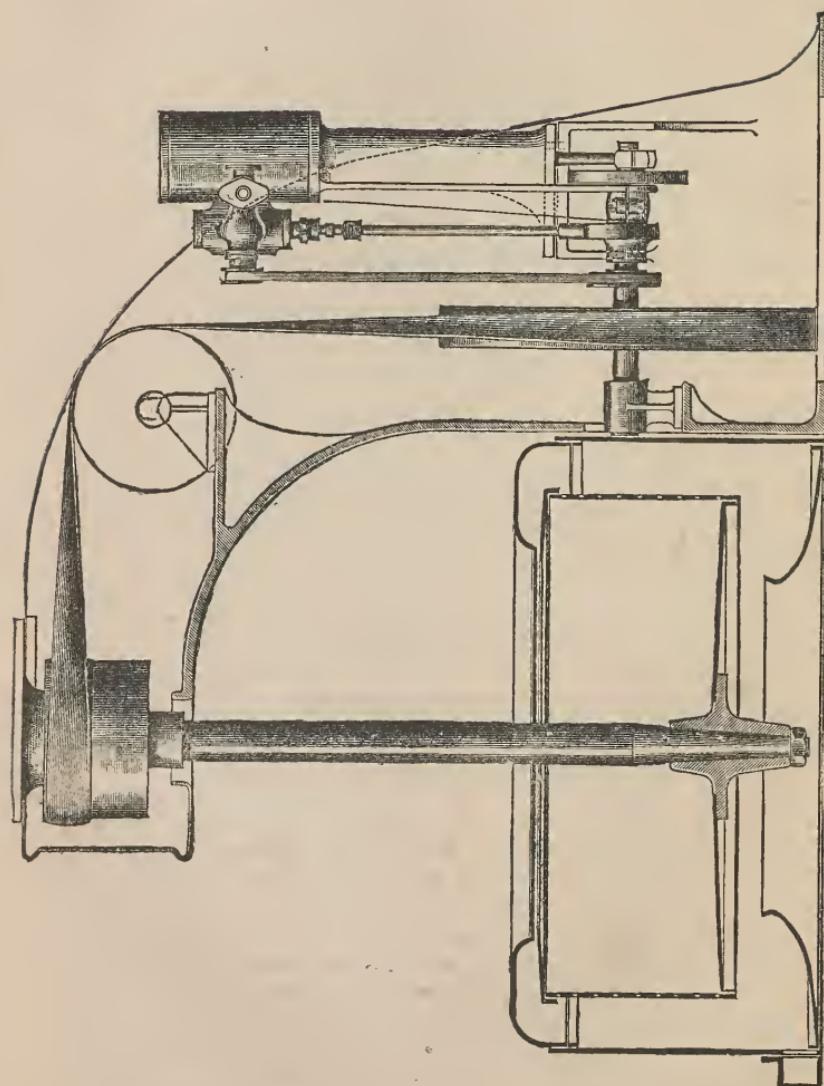


Fig. 22.—Belt driven overhead hydro-extractor.

than the hydro figured in Fig. 21, but the want of multiplying gear will necessitate that it be attached to a shaft which is run at a fairly high rate of speed. The filling and emptying of this

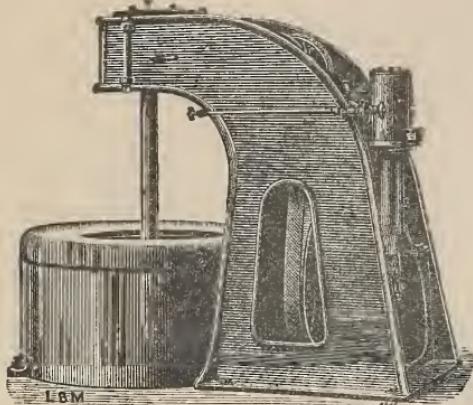


Fig. 23.—Self-balancing overhead hydro-extractor.

form of hydro can be easily effected, as there are no projections or arms above the top of the hydro.

Fig. 25 illustrates a type of hydro which is over-driven. This form also represents a mode of driving hydros which is favoured

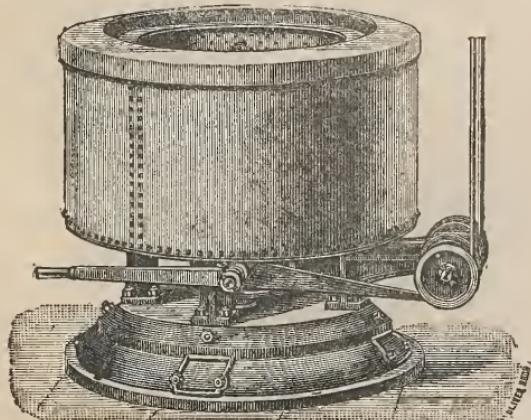


Fig. 24.—Under-driven hydro-extractor.

by some makers—viz., by a pair of friction cones ; this mode of conveying the power is not so noisy as that by spur wheels, is less troublesome than that with belts, while the speed can be

more easily regulated by altering the pressure of the friction cone on the other cone. The starting or stopping is done by a cam handle.



Fig. 25.—Top-driven hydro-extractor.

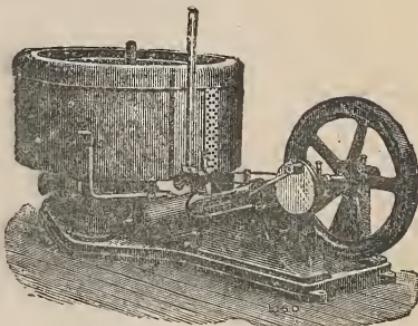


Fig. 26.—Under-driven hydro-extractor.

Fig. 26 shows a self-contained hydro, but one where the driving arrangement is underneath.

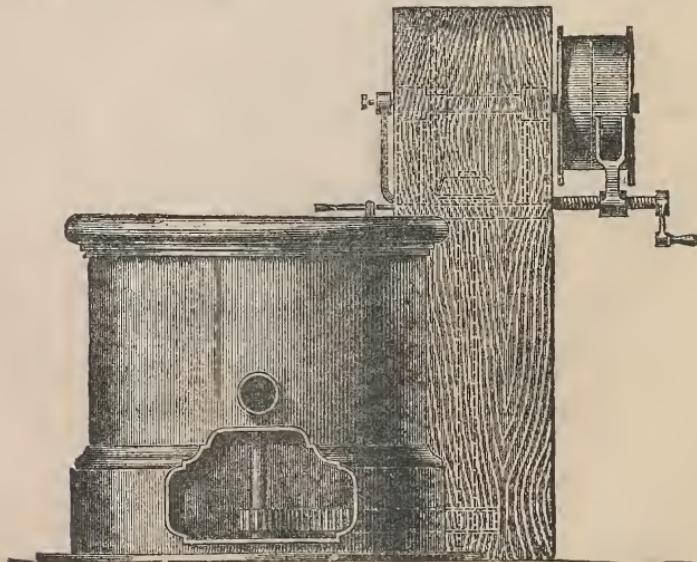


Fig. 27.—Light-power hydro-extractor.

These direct driven forms of hydros are, as has already been pointed out, very convenient where large ones are to be used and plenty of steam is available.

Fig. 27 shows a hydro-extractor, to be driven with power specially adapted for those places where the amount of work is rather too large for a hand hydro-extractor, but not sufficient for a large size power hydro. It is of the under-driven type, and is fitted with multiplying gear with friction cones. No heavy foundations are required, the cage is at a convenient height for filling, and the power required is but small.

Fig. 28 shows an under-driven hydro, where all the working

parts are underneath, and the workmen cannot, therefore, come in contact with them, which will result in fewer accidents happening. Compared with over-driven hydros it is more accessible, and is, in consequence, easier filled. The surplus water runs out of a large opening in front of the machine.



Fig. 28.—Under-driven hydro-extractor.

inner cage can be readily stopped. The lever for actuating the brake is shown in some of the above figures.

Hydros are very simple to work ; all that is necessary is to pack the goods well round the sides of the inner cage, taking care that one side of the cage does not contain a heavier weight of goods than the other ; in other words, that it is properly balanced, so that when it is set in motion it will revolve freely. When one side of a hydro is filled more than the other there is a tendency for that side to move away from the centre, and so there is too much friction put on the central bearings, which tends to cause unequal wear, while retarding the speed at which the hydro can be driven.

Generally, when the goods are removed from the hydro they will be found sufficiently dry for all the finishing operations ; the quantity of moisture which may be extracted from textile fabrics by the hydro depends, of course, primarily upon the quantity in the goods, but also on the speed of revolution of the inner cage of the hydro and the length of time the goods are allowed to be treated. The quicker the speed, as also the longer the time, the more water is taken out by the hydro.

As the operation of finishing the goods ready for sending out to the customer depends so much on the character of the fabric of which they are made, it will be more convenient if these are described in relation to their peculiarities.

**Finishing Lace Curtains.**—These are mostly white goods, and require to be finished stiff. Lace curtains are rarely coloured, but, if required to be tinted, the dyer should endeavour to use dyes which, while colouring the curtains of the desired tint, shall, at the same time, be removable when next the curtains are washed and cleaned. For this purpose the cleaner will find it best to use such dyes as the basic or acid dyes, which will usually impart a sufficiently deep tint, but which are readily removable by washing. Messrs. William Edge & Sons, of Bolton, make a series of tinting colours for lace curtains which have this peculiarity.

After going through the hydro, the next operation consists in starching them ; an operation of too familiar a character to need a full description here. The cleaner will find that a good wheaten starch will give him the best results ; it should be mixed with boiling water, and, after mixing, it may be boiled up again for a few minutes to ensure that the starch granules are fully swollen ; but the boiling must not be too prolonged, as that would have a tendency to make the starch become thin and lose a great deal of its stiffening properties. After being starched, the curtains may be stretched upon frames and left to dry. Great care should be taken in so placing the curtains on the stretchers that they may be uniformly stretched in every direction. When dry they may be folded, and then placed under a press and pressed for about two minutes.

Combined curtain stretchers and drying rooms are made, and are much used where large quantities of curtains are dealt with. These take the form of a room built up of wood and heated with a layer of steam pipes on the bottom, and provided with a fan for the purpose of drawing air and water vapour out of the chamber in order to facilitate the operation. One end of the chamber is really formed of a series of flaps, and on a level with each of these are fixed on the two side walls pairs of guides on which the frames carrying the stretched curtains can slide. The frames are formed of a pair of rails, whose distance apart can be regulated by screws, and so can be adjusted to suit different widths of curtains. These rails carry pins, and on these girls stretch the curtains, taking care to do so as evenly as possible. When a curtain has been stretched on a frame, it is sent through one of the flaps into the drying chamber. Generally

speaking, it does not take long to dry a curtain in this appliance. Usually by the time all the frames are filled and put into the chamber, the first one will be ready to be taken out and sent on to the next process.

In some cases curtains, silks, damasks, &c., are finished on frames which consist of two long rails provided with hooks or pins for holding the articles, and which, by means of screws, can be adjusted at various distances apart to suit different widths of curtains, &c. These rails have suitable supports. Underneath the frame, and, therefore, under the curtains, silks, &c., are arranged a couple of carriages running on rails; one of these carries a steamer, so that by moving it along the whole of the curtain or silk can be steamed. Another carriage carries a gas heating arrangement which, in its motion under the article stretched on the frame, dries it and completes the operation.

If the cleaner has a large number of curtains to deal with, it will be worth while to have a simple calender with two rolls, one of steel, the other of paper, the steel roll or bowl being so constructed as to be capable of being heated by gas. Fig. 29 represents such a calender. A passage through such a machine will straighten the curtain and stiffen it at the same time. It is obvious that all creases must be taken out of the curtain before it is calendered. They are dealt with much more rapidly and effectively than by the stretcher system.

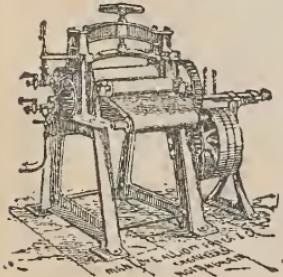


Fig. 29.—Calender.



Fig. 30.—Ironing machine.

The stiffness of the curtains is regulated by the amount of starch given to them; this is a point on which no definite rules can be given in a book of this description; experience must be the cleaner's guide in such matters. It may be added that the thicker the starch liquor through which the curtains are passed the stiffer they will be. By adding a little paraffin wax or spermaceti to the starch a glaze can be put upon the curtains.

Instead of a calender, an ironing machine, such as that shown in Fig. 30, may be used with advantage for lace curtains.

**FINISHING DAMASK, CRETONNE CURTAINS, AND SIMILAR FABRICS.**—These goods generally simply require smoothing out before sending home; this can be done either by the calender or by the ironing machine. Should a little stiffness be desired, then they may be treated with a little weak starch. They should be just damp, and no more, before passing through the machines; and these should be sufficiently warm or hot to drive off the excess of moisture and leave the goods dry.

**RIBBONS, LACES.**—These should be passed through either a little thin starch or a weak solution of gelatine, and then ironed or calendered, as is most convenient.

**GARMENTS, LADIES' AND GENTLEMEN'S CLOTHES,** are best ironed out while just damp, either by a hand iron or by machine, according as the character of the garments or the conveniences at command will allow.

Various appliances have been devised from time to time for the finishing of garments of all kinds. In Fig. 31 is shown a steam cone which is exceedingly useful for dealing with ladies' skirts. This is made usually of strong tinned copper, and steam is sent into the interior through valves and pipes provided for the purpose. The cone requires three people to use it. The garment is slightly damped, for which purpose spraying machines have been devised by Messrs. David Gorrie & Sons, and then stretched over the cone, one person holding it down firmly at the narrow end, two other persons holding it down by special hooks at the wide end, for a few minutes; every part of the garment is thus dealt with.

In Fig. 32 is shown what are called steam bolts or bullies; these are tubular devices of various shapes, as is seen in the drawing, and which can be heated by steam. These are kept very bright, and by stretching the various articles over them, choosing that shape which will best suit the piece in hand, a finish can be easily and quickly given not readily obtainable in other ways.

**VELVETS, PLUSHES, AND OTHER PILE FABRICS.**—These are by far the most troublesome kinds of goods the cleaner and dyer has to deal with. As they come from his cleaning or dyeing vessels they are somewhat unlovely articles, being full of creases and the pile more or less flattened. Whatever processes they are passed through it is essential that the pile be raised up again as much as possible, and it is obvious that the process of ironing or pressing is not applicable to these fabrics.

The plan on which to deal with such fabrics as are now under discussion is to subject them to a steaming process working from

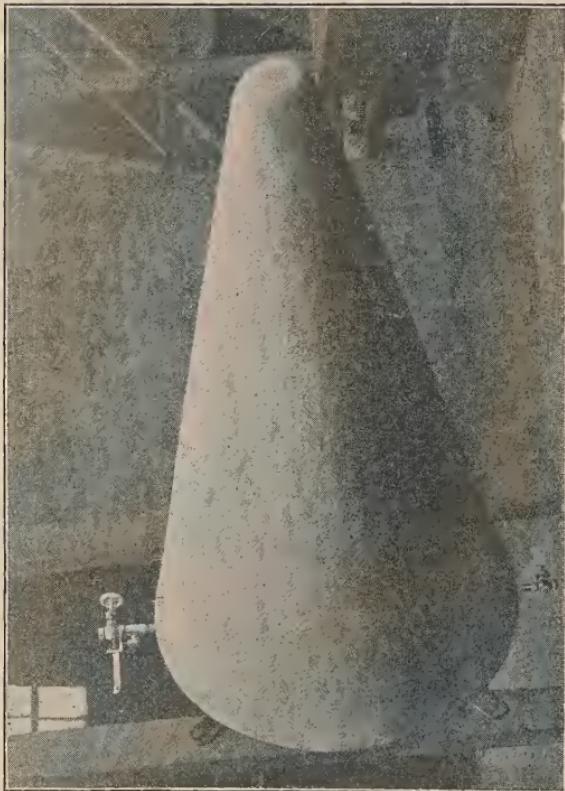


Fig. 31.—Steam cone for finishing goods.

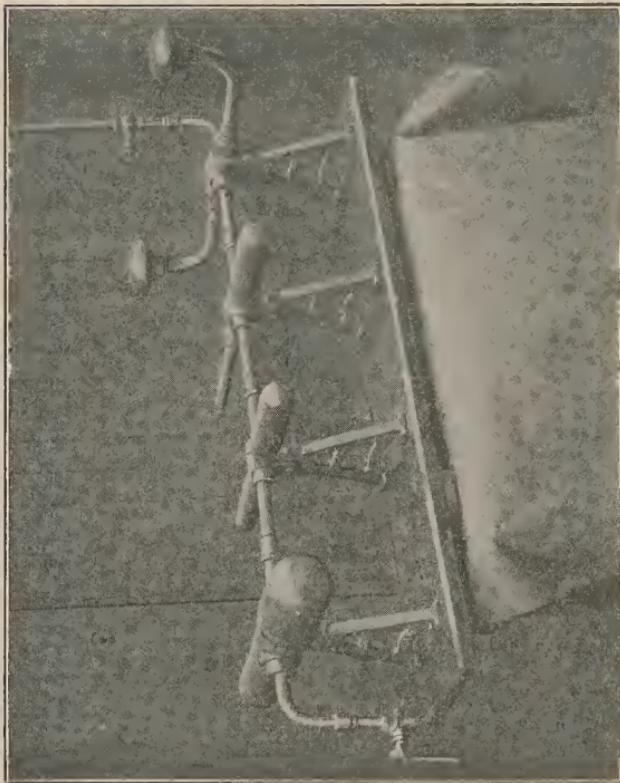


Fig. 32.—Steam bolts or bullies.

the back ; the steam rising through the cloth raises up the pile in a very effectual manner. One of the best arrangements for effecting this is shown in Fig. 33. This is made to be fastened

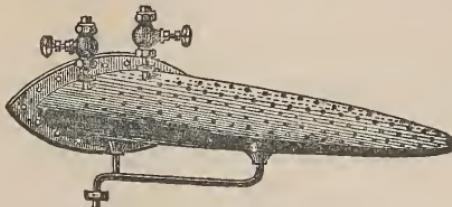


Fig. 33.—Steamer.

against a wall. Pipes convey steam into it, while there are also exit pipes for condensed water and surplus steam. The top is perforated with a large number of holes. The machines are made of various sizes, but a good size would be 4 to 5 feet long, and about a foot broad. The goods, the pile of which is to be raised, are drawn over this steamer while a current of steam is being sent through. The operation is a very simple one, and is easily carried out. If once passing over does not secure the desired effect, repeat the operation.

The steamers may be made with either a pointed end, as shown in the figure, or with a round end ; generally, however, the former shape is preferred.

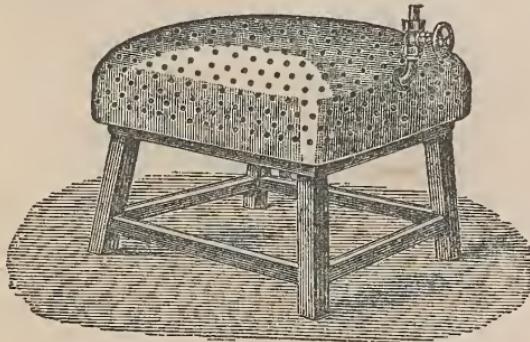


Fig. 34.—Steaming table.

Another form in which these steamers are made is that of a table with a rounded top, as shown in Fig. 34.

If steam is not available, then a steamer is used, made as

shown in Fig. 35, which represents a steamer kettle. It may be made in tin, zinc, or copper; but the latter, although the most expensive, is by far the best and most durable. It consists of a case 2 feet long by 6 inches deep; one end is curved as shown, at the other end is a shallow extension about a foot long and

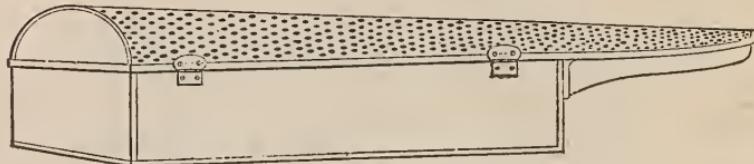


Fig. 35.—Steaming kettle.

1 inch deep. The top is perforated, hinged to the case, and made to fit tightly so that no steam can escape from the sides. The top is rounded. If this kettle is placed over a powerful gas burner, sufficient steam is generated to steam any kind of velvet or pile fabrics.

Generally it will be found best to cover the steamers with a piece of woollen felt, which will cause a more uniform distribution of the steam through the fabric. Brushing at the same time will also assist in raising the pile, especially if it has been much crushed by the previous operations.

Before steaming it may be advisable to give them a thin coating of starch or gelatine size, which will give the fabrics a stiffness when they are dried.

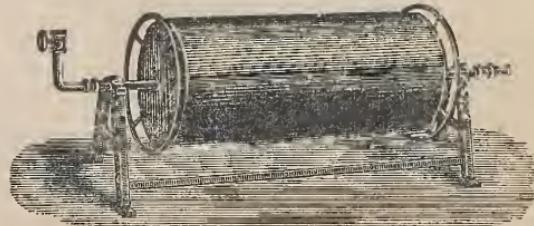


Fig. 36.—Drying cylinder.

After being steamed the velvet or plush should be dried quickly, by passing it, back down, over a drying table or drying cylinder. Figs. 36 and 37 show respectively a cylinder and a table heated by steam; their construction is readily seen from the figures. Whatever steam arises from the still damp

fabrics from the steamer also assists in raising the pile; at the same time the drying causes any such finishing material as starch or gelatine to stiffen the fabrics.

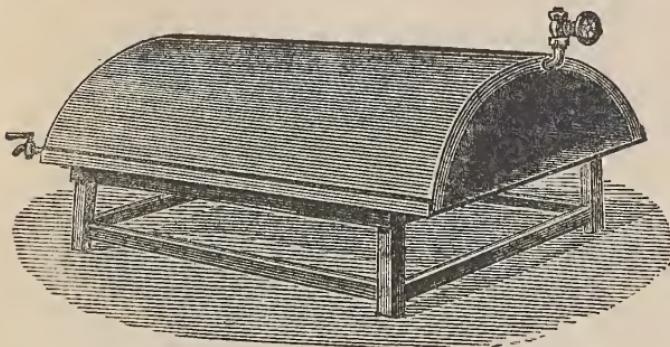


Fig. 37.—Drying table.

Generally, what has been said above will cover the great bulk of the goods which pass through the hands of a dyer and cleaner. Some kinds of articles, such as gloves, feathers, &c., will be found given in the special chapters relating to them.

There is just another point in the finishing of dyed and cleaned articles to which attention may be directed at this stage, and that is the drying of washed dresses, &c. There is no better method of drying than air-drying; but in this country the climate is of too uncertain a character to make this method always available, while, also, it requires a large area of ground which, again, is not always at command.

It is, therefore, necessary in large cleaning and drying works to make use of heated chambers in which to dry the goods. Two such chambers are shown in Figs. 38 and 39.

Fig. 38 shows a drying chamber heated by steam coils placed underneath. The garments, &c., are hung on a framework, which is made to run in and out on rails, as seen in the figure. This is very effectual and works well.

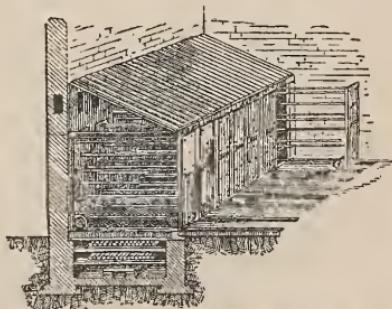


Fig. 38.—Steam drying chamber.

Fig. 39 shows a large drying chamber heated by a furnace placed underneath; this, however, can be replaced by a row of steam pipes, if steam is available, or by blowing a current of hot air through the chamber. The articles to be dried are hung on rails attached to a series of frames which can be drawn in or out of the chamber for the purpose of filling or emptying, the

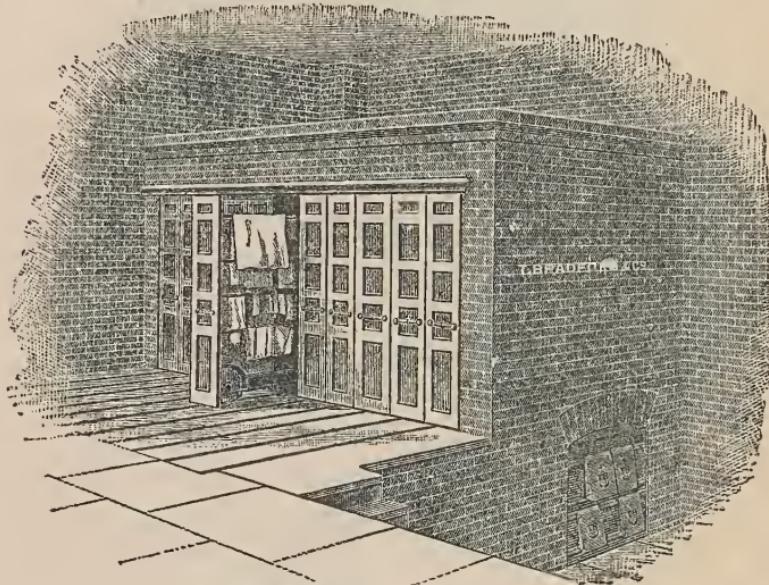


Fig. 39.—Drying chamber.

arrangement being very well shown in the figure. These drying chambers are very efficient, require but little attention, and get through a large quantity of articles.

Many other forms of drying chambers are made, but any of the above will answer the purpose of the general dyer and cleaner.

## CHAPTER VI.

## SCOURING AND DYEING OF SKIN RUGS AND MATS.

ONE of the most difficult branches of the dyer's art is that of dyeing or colouring rugs and mats made of skins of various kinds; this arises from the operation of two different factors; first, that wool and animal furs have the greatest affinity for colouring matters at the boiling point, in fact some colours, notably the acid blacks, will not dye such fibres except at the boil; secondly, the pelt or skin is completely disintegrated at temperatures above 170° F., it shrivels up and becomes hard and brittle, and the higher the temperature to which it is exposed the greater is this effect, or defect, developed. Now it is obvious that this latter property of the pelt militates very much against the dyeing of skins, for such cannot be treated at any higher temperature than 150° F. to ensure complete immunity from risk of spoiling the pelt, while, at such comparatively low temperatures, most dyestuffs have very little affinity for wool or other animal fibres; so that, owing to the operation of the two causes referred to, it is by no means an easy matter to obtain full, solid shades on skins.

The skin rugs or mats which are to be cleaned and dyed are stretched and fastened to wooden boards or wooden frames of a convenient size; the skins should be stretched tightly or, otherwise, during the process of drying, after being finished, they may shrink very greatly; this must be avoided, especially if the rug or mat is to be as supple as it is possible to be made, since in shrinking such articles lose their suppleness. The skin does not need to be removed from the boards or frames during the whole of the operations through which it passes.

All operations connected with the cleansing and dyeing of skins are carried out in shallow wooden troughs, which are best lined with lead; the troughs should be made large enough to receive the largest skin which has to be dealt with, say 7 feet 6 inches long by 3 feet 6 inches wide. The depth may range from 8 to 12 inches. Smaller sized troughs may be provided, in which to deal with small skins, so as to economise the amount of dye liquor used as much as possible. It should be mentioned

that, in no case is the whole of the skin immersed in the dye or cleansing liquors ; the pelt or skin itself is supported out of the liquor, to minimise as much as possible the effect of hot liquors upon it. The depth of dye liquor used for any particular skin should be regulated according to the length of the fibre or hair of such skin ; those with long fibres require greater depth of dye liquor than those with short fibres ; this, of course, is a point which can easily be arranged by the dyer or cleaner. The important point is to allow the fibres of the skin to hang freely in the liquor so that little or no felting, or matting, of the fibres together will occur, a feature which is, perhaps, more likely to happen in the preliminary cleansing operations than in that of dyeing.

**CLEANSING SKIN RUGS AND MATS.**—The first operation is that of cleansing or scouring the skins to free them from grease, either natural or imparted, which they may contain. Sheep skins in particular, when new, are very greasy, and this enables them to hold a great deal of dirt. Before any good effects in dyeing can be obtained on such skins, all this grease and dirt must be removed. This is best effected by washing them with a soft potash soap.

Fill a trough with water which is heated to about  $120^{\circ}$  or  $130^{\circ}$  F., throw into it a little soap, then dip in the rug or mat or skin which is to be cleaned ; lift this up and down in the troughs several times, then turn over the article, and, by rubbing with the hand, work the soap well into the substance of the skin and fibre ; dip it again into the soap liquor and repeat the operations several times. Next, transfer the skin to a trough of clean water and wash or rinse out the soap from the skin. Should the skin not be perfectly clean, prepare a new soap bath and treat the skin in this in the same way as before. Should the skin be very dirty the addition of a little ammonia to the soap bath will increase its cleansing properties. A very great difference will be found in the quantity of dirt and grease the skins contain ; some will require much more labour in freeing them from dirt than others ; but, in general, two or three applications of soap will be found sufficient for all skins. Do not use too hot liquors, but such as can be just used in comfort by the hands, so that the soap liquor can be well rubbed into the fibre and the pelt.

A potash soft soap, one made from a mixture of tallow and cocoa-nut oil will be found to give the best results, leaving the fibre soft and silky looking. The ordinary hard soaps have a tendency to leave the fibre harsh and to take away from its

lustre. It is important that the soap used should be as neutral as possible. Some of the ordinary makes of soft soap contain too much free alkali to be suitable for cleansing skins, skin rugs, and skin mats.

After being scoured, the skins, &c., should be allowed to drain to rid them of the surplus water they contain; it is not necessary that they should be dried completely at this stage of treatment. This draining may be expedited by the skin being placed in a hydro; or by the frame, to which the skin is fastened, being attached to a whirling table, which drives the water out of them by centrifugal action.

Generally, the skins, rugs, or mats will, after this treatment with soap, be clean enough and of a sufficiently light colour, even if they be not quite white, for dyeing; there may be exceptions when light tints are wanted; for all dark colours and shades it is not necessary that the skin should be white. In the case of skins, rugs, and mats, intended to be white or dyed in pale tints, the cleansing process must be supplemented by a bleaching process. It will be found scarcely possible to bleach all skins and such articles to a good white; some are naturally of a very dark colour, and this colour cannot be completely discharged by any bleaching process without, at the same time, running a great risk of destroying the article. Dyers and cleaners, therefore, must exercise a little judgment as to what skins they subject to the bleaching process; none but those which are already of a faint cream tint should be subjected to further treatment with a view of obtaining a white skin.

**BLEACHING OF SKINS, RUGS, AND MATS.**—Several processes are available; those which are commonly used depend upon the bleaching action either of sulphurous acid gas evolved by the burning of sulphur or of peroxide of hydrogen.

*Bleaching or Stoving with Sulphur.*—To carry out this process a room should be so constructed that it can be closed quite air tight. It should have two floors; a true solid floor, on which the sulphur is placed for burning; and, a foot above this, a false floor, perforated with a number of holes; the object of this second floor is twofold, to more completely cause the diffusion of the gas evolved from the burning sulphur throughout the chamber, and to prevent any unburnt particles of sulphur from becoming deposited upon the goods which are being stoved. In the upper part of the chamber are arranged a number of wooden rails on which the skins or other articles to be bleached are hung.

The operation of stoving or bleaching with sulphur is carried

out in the following manner—On the floor of the chamber are placed a few bricks, and on these an iron pan with 2 or 3 pounds of sulphur; the chamber is now filled with the goods which are to be bleached, and the sulphur fired. A very convenient way of doing this is to pour over it a little methylated spirit, and to set fire to this, thereby causing the sulphur to ignite. The door of the chamber is then closed and left for a period of twenty-four hours, after which it may be opened and the goods taken out; generally, they will be found to be a fair white; if not, a second treatment may be necessary. The bleach is not a permanent one, as the colours may return after the articles have been exposed to the air for some time.

*Bleaching with Peroxide of Hydrogen.*—This is, perhaps, the most satisfactory process of bleaching, and with care good results can be obtained. The method of using this article has already been described on p. 116. In applying it to the bleaching of skins, the bath may be made a little stronger; after the skins have been steeped in the bleaching liquor it is a good plan to take them out and allow them to lie in a damp condition for some hours, re-dipping them into the bath to complete the operation. The second time the bath may be used at about 120° F.

*Bleaching with Peroxide of Sodium.*—Peroxide of sodium is a bleaching agent, which has been recently introduced by the Aluminium Co. of Oldbury, near Birmingham. It is a greyish-white powder; when thrown into water it dissolves with the evolution of some heat and often with flashes of fire, due to its containing particles of the metal sodium; it forms a strongly alkaline solution containing peroxide of hydrogen. By adding acid the alkalinity is neutralised, and a very strong solution of peroxide of hydrogen is then obtained; in this way a bleaching solution of great power can be prepared. One method of using it is to prepare a solution in water, then to neutralise this with sulphuric acid, afterwards adding sufficient ammonia to ensure that the bath is alkaline, as the bleaching is more effectual in alkaline than in acid baths. The goods are treated in this bath in the same way as is done when using peroxide of hydrogen.

Another mode of using peroxide of sodium is to make a solution in water as before; then to add to the alkaline liquor so prepared a solution of Epsom salts, magnesium sulphate, using of this latter body about three times the weight of the peroxide. The precipitate of magnesium hydroxide which is obtained may be disregarded; the skin is worked in the solu-

tion, best at a temperature of 100° F., for two or three hours, then lifted and exposed to the air for an hour or so, then, if not sufficiently white, it is returned to the bleaching bath for a little while longer, next it is rinsed in water, passed through a weak sulphuric bath, again rinsed in water, and dried.

Peroxide of sodium is a fairly stable body, but great care is needed in storing and handling it; in particular it must not be allowed to come in contact with wood, paper, or other organic bodies or it may cause these to take fire. In respect to stability and, therefore, adaptability for keeping it possesses some advantage over peroxide of hydrogen; where bleaching is an operation which is done at irregular intervals, peroxide of sodium is more convenient than peroxide of hydrogen, although the cost is, if anything, higher in the case of the sodium compound than with the hydrogen compound.

The solution of peroxide of sodium should be proceeded with carefully and but small quantities be dissolved at a time; otherwise, there is considerable risk of losing the oxygen from the product, and thereby reducing the bleaching power of the solution, besides running the risk of disastrous results happening.

**DYEING OF SKINS, RUGS, AND MATS.**—The difficulties attending the dyeing of skins, rugs, and mats have already been described, together with the reasons for such difficulties. A further difficulty arises from the impossibility of giving any very definite quantities of dyestuffs to be used in the operation of dyeing; this is due to the size and weight of, and, more particularly, the quantity of hair or fibre attached to the skins, varying so much, that what would be sufficient for one skin will be quite insufficient for another; hence the dyer of such articles must be guided by his own practical experience. However, it may be safe to say that the best general rule to follow will be to take but small quantities to start with and add more as the progress of the dyeing operations shows to be necessary. The following recipes are intended to show the proportions of the different dyewares which are to be used as well as the quantities for any particular dye bath:—

1. **Black on Skin Rugs and Mats.**—Prepare a bath with 17 parts of logwood extract and 10 parts of cutch; in this steep the skins for two hours, turning them from time to time to ensure that the liquor penetrates well into all parts; then lift, add to the same bath 2 parts of bluestone, re-enter the skins, work for a short time, then raise the temperature to 90° or 100° F., and keep at this heat for two hours; then lift, drain,

and enter into a bath of logwood and cutch only at 100° F. for two hours; then add to the first bath 3 parts of copperas, place the skins in this bath at 100° F. for two hours, at the end of which time they will usually have a good colour; if not, repeat the operations. Skins vary so much as to their affinity for colouring matters that what would be sufficient time for one skin may not be long enough for another.

2. **Black on Skins.**—Prepare a dye bath with 4 parts of logwood extract,  $1\frac{1}{2}$  parts of fustic extract,  $1\frac{1}{4}$  parts of sumach extract, and  $\frac{1}{2}$  part of argol; heat this to 110° F., enter the skins and work for two to three hours; then lift and enter into a fresh bath containing 1 part of copperas and  $\frac{3}{4}$  part of bluestone; work in this for one hour; then lift, drain, and re-enter into the first dye bath, working for one hour; then lift, drain, and re-enter into the second bath; by repeating these operations, working at a temperature of 120° to 130° F. in the final treatments, a good black will be developed.

3. **Black on Skins.**—Treat the skins for two or three hours in a bath made with 3 parts of bichromate of potash, 2 parts of copperas, and 1 part of bluestone, working at from 120° to 130° F. The addition of 3 parts of argol will improve the process. Then prepare a bath of 8 parts of logwood extract and  $1\frac{1}{2}$  parts of fustic extract at 120° F.; into this place the treated skins and work for some time until a black is obtained. To ensure this end it may be advisable to enter them again into the first bath for a short time. The process is not one which can be strongly recommended.

4. **Black on Skins.**—Prepare a dye bath with 15 parts of logwood extract, 10 parts of sumach extract, 2 parts of verdigris, and 5 parts of iron liquor. Heat to 100° F., enter the skins and keep them in the bath until they have acquired a good shade. This process is one of the best methods of dyeing blacks on to skins of all kinds, inasmuch as the black only requires a low temperature for developing it, which is a great advantage in the dyeing of skins.

Blacks cannot be dyed on skins with the aid of the coal-tar blacks, such as the Acid blacks of Messrs. Read Holliday & Sons, the Naphthol blacks of Messrs. Cassella & Co., the Victoria blacks of the Farbenfabriken vorm. F. Bayer & Co., and other blacks of a similar nature; for these a boiling bath is absolutely necessary for the full development of the colours on the wool or other animal fibres and, for reasons previously pointed out, this is not permissible in the case of dyeing skins.

For dyeing colours such as reds, yellows, blues, &c., on skins and similar articles the dyer must have recourse to the artificial coal-tar colouring matters; the natural dyestuffs are not generally available, owing to the fact that they require the aid of mordants to fix them on the wool or fibre, whereas mordanting is an operation which cannot be carried out with good results in skin dyeing.

Of the coal-tar colours those termed basic colours, which dye wool and silk and other animal fibres from a neutral bath, such as Magenta, Safranine, Chrysoidine, Auramine, Brilliant green, give the best results, and with the aid of these all shades may be dyed on to skins.

The acid and azo dyes do not work well on to this class of goods; in general they require a high temperature for full shades to be developed and this is not permissible; for producing dyed tips on skin mats they may be used with good results, inasmuch as in tip dyeing there is but little risk of the hot dye liquor coming in contact with the pelt. There are a few of the acid and azo coal-tar dyes which may be used in dyeing skins.

In using the basic coal-tar colours in skin dyeing, some care is required to obtain uniform tints throughout the substance of the fibre on the skin; the affinity of the colouring matter for the fibre is so strong, and the dye liquor comes into contact with the tips of the fibres more freely than the root ends, that uneven tints are obtained; this is more perceptible with such dyes as Magenta, Violet, Blues, with which it may happen that the tips will have become of a bronzy colour before the roots have become tinted; this defect may be got over to a large extent by using weak baths at as low a temperature as possible, and adding a neutral salt, like Glauber's salt or common salt, to the bath, also by turning the skins over from time to time and allowing the dye liquor to drain down to the roots.

**5. Crimson on Skins.**—Use 1 part of No. 2 Magenta B dissolved in 100 parts of water, adding 10 parts of Glauber's salt. Care must be taken or the tips will acquire a bronzy colour.

**6. Scarlet on Skins.**—Make the dye bath with  $1\frac{1}{2}$  parts of No. 2 Magenta B, 1 part of Auramine, and 10 parts of Glauber's salt.

**7. Scarlet on Skins.**—Make the dye bath with 2 parts Azo cochineal, 10 parts of Glauber's salt, and 2 parts of sulphuric acid. When using an acid dyeing colour, like the one here named, it is a good plan to prepare the bath without the acid, work the

skins in the bath until they are thoroughly impregnated, then add the acid, and finish the dyeing; more uniform shades are thereby obtained.

8. **Rose Pink on Skins.**—Make the dye bath with Azo cochineal, as in the last recipe, but use it weaker and only for the time required to develop.

9. **Rose on Skins.**—Make the dye bath with 1 part of Eosine A, 10 parts of Glauber's salt, and 3 parts of acetic acid, working until the desired shade is obtained. Rose tints dyed with Eosines, although very bright, are rather fugitive to light.

10. **Maroon on Skins.**—Prepare the dye bath with 1 part of Magenta, 10 parts of Glauber's salt, and a little Nile blue.

11. **Claret Red on Skins.**—Use Magenta, shading with a little Chrysoidine.

12. **Bright Lemon Yellow on Skins.**—Prepare the dye bath with 1 part Thioflavine T, and 10 parts of Glauber's salt.

13. **Deep Yellow on Skins.**—Use 1 part of Auramine II and 10 parts of Glauber's salt.

14. **Bright Yellow on Skins.**—Prepare the dye bath with 1 part of Naphthol yellow S, 10 parts of Glauber's salt, and 2 parts of sulphuric acid.

The three yellow dyestuffs named in the above recipes all work on to the skins in a very satisfactory manner, bright, full shades being readily obtained. They will be found very useful in combination with other dyestuffs to form a variety of shades; the Auramine and Thioflavine T in conjunction with basic dyes like Magenta and Bismarck brown; the Naphthol yellow in combination with acid dyes like Azo cochineal and Eosine.

15. **Orange on Skins.**—Use 1 part of Crocein orange, 10 parts of Glauber's salt, and 2 parts of sulphuric acid, or there may be used 1 part of Orange extra, 10 parts of Glauber's salt, and 2 parts of sulphuric acid. Both dyestuffs give full bright shades.

16. **Bright Blue on Skins.**—Prepare the dye bath with 1 part of Nile blue A and 10 parts Glauber's salt. This gives a bright blue of a greenish tone.

17. **Bright Blue on Skins.**—Use 1 part of Victoria blue 4R and 10 parts of Glauber's salt. This gives a blue of a violet tone.

18. **Dark Blue on Skins.**—Dye a grey by using Induline or Nigrosine, then a blue with Victoria blue 4R, as above.

It is a difficult matter to dye dark blues on skins; the best method of working will be, as indicated in last recipe, to first dye a grey by any means, then to top with Victoria blue.

19. **Violet on Skins.**—Use 1 part of Methyl violet B and 10 parts of Glauber's salt. No difficulty is experienced in dyeing violets; the difficulty is to prevent the tips from becoming bronzy; this can be overcome by working according to hints given above. As to brands of Violets, see p. 74, the remarks there made being applicable also to skin dyeing.

20. **Green on Wool.**—Prepare the dye bath with 1 part of Green crystals Y and 10 parts of Glauber's salt. This gives a bright green shade of a somewhat bluish tone.

21. **Bright Green on Skins.**—Prepare the dye bath with 1 part of Green crystals Y,  $\frac{1}{4}$  part of Auramine, and 10 parts of Glauber's salt.

22. **Olive Green on Skins.**—Prepare the dye bath with 1 part of Brilliant green,  $\frac{1}{2}$  part of Chrysoidine, and 10 parts of Glauber's salt.

23. **Bronze Green on Skins.**—Prepare the dye bath with 1 part of Brilliant green,  $\frac{1}{2}$  part of Bismarck brown, and 10 parts of Glauber's salt.

24. **Peacock Green on Skins.**—Prepare the dye bath with 1 part of Malachite green,  $\frac{1}{4}$  part of Nile blue A, and 10 parts of Glauber's salt.

25. **Bismarck Brown on Skins.**—Prepare the dye bath with 1 part of Bismarck brown R and 10 parts of Glauber's salt.

26. **Walnut Brown on Skins.**—Prepare a dye bath with 1 part of Bismarck brown R,  $\frac{1}{4}$  part of Nigrosine, and 10 parts of Glauber's salt.

27. **Brown on Skins.**—Prepare a dye bath with 3 parts of Benzo brown and 10 parts of salt.

28. **Silver Grey on Skins.**—Use a bath made with 1 part of Nigrosine and 10 parts of Glauber's salt.

Skins, furs, &c., are often treated with alum, mercury chloride, arsenic, and similar bodies, with a view to preserve them from insects, &c. Generally such preservatives have but little influence upon the operation of dyeing; as a rule, they increase the affinity of the fibre for the natural dyestuffs or some of the mordant dyeing coal-tar colours; if alum has been used as the preservative logwood blacks will be slightly reddened in tone,

but, in general, the shades will not be much affected by such preservatives.

**FINISHING THE SKINS.**—After being cleaned and dyed, the skins require to be dried. This should be done while the skins are stretched so as to prevent shrinkage, which always causes the skins to become hard. From time to time during the drying operation the skins should be well shaken, so as to open out the fibre and prevent any matting taking place. After being dried the fibre side of the skins should be well brushed to separate the fibres as much as possible. To soften the skins they may be rubbed on the flesh side with a little oil or a mixture of oil and the yolk of eggs. Cod oil or castor oil soften the skins better than any other oils. As a preservative a little mercury chloride added to the oil will be the best, 1 oz. will be amply sufficient to add to 3 gallons of oil.

With a view of increasing the affinity of the wool for dyes, and, therefore, facilitating the dyeing of skins and furs, they may be treated with chloride of lime (bleaching powder). The best manner of doing this is to first prepare a clear solution of bleaching powder, allowing not more than 1 to  $1\frac{1}{2}$  lbs. to each 100 lbs. weight of skins. Steep the wool or hair portion of the skin in this for about ten minutes; then lift and pass at once into a bath of hydrochloric acid at  $2^{\circ}$  Twaddell, allowing to remain in ten minutes, then lift out, rinse, and the skin is then ready for dyeing. Not more than the quantity of bleaching powder given should be used, or the wool of the skins will become discoloured and harsh.

## CHAPTER VII.

## CLEANING AND DYEING OF FEATHERS.

THE cleaning and dyeing of feathers is a most important branch of the dyer's art, and one that is most difficult to effect with complete success. Feathers are obtained from a great variety of birds; these vary very much in their hues, from the white of the swan to the black of the blackbird, so that the colours of feathers are as numerous, or nearly so, as the variety of birds. Of the nature of the colouring matters of feathers but little is known; one thing is certain, they are of a very permanent nature, usually resisting exposure to air and light for very long periods, while many of the darker coloured feathers are exceedingly difficult to bleach. The affinity of feathers for colouring matters varies very greatly; some kinds of feathers dye more easily than others, chicken feathers are rather more easily dyed than ostrich feathers.

As far as regards the affinity of feathers for colouring matters, they in general closely resemble the wool fibre; for the basic coal-tar colouring matters they have a direct affinity, and will combine with them at once from a plain bath. There is some degree of difference not only between feathers from different birds, but also in feathers from different parts of the same bird, and in different parts of the same feather (as the plumes of the feathers dye quicker than the stem) in their affinity for dye-stuffs. The acid and azo coal-tar colours can be applied to feathers in a bath containing Glauber's salt and sulphuric acid in the same way as in wool and silk dyeing; this class of colours gives the best results in the dyeing of feathers, more uniform shades being obtained by their means than by the use of the basic coal-tar colours. The mordant dyeing colours do not dye very well on feathers, due chiefly to a want of affinity of the feather substance for the mordant; necessarily if the mordanting is not effectually done the dyeing must suffer.

Feathers naturally contain a large proportion of grease; some, such as those of ducks and of all aquatic birds, more so than others. Before they can be properly dyed it is essential that this grease be removed; the stem or quill of the feathers con-

tains more grease than does the plume, and owing to the denser nature of the quill substance is much more difficult to remove. In the treatment of feathers it follows that the first proceeding must be to remove this grease. If the feathers are to be dyed in light tints, it is needful that they should be white, or nearly so, before they can be dyed in satisfactory tints. As feathers, however, are more or less coloured, they must be bleached. It may, however, be pointed out that it would be useless labour to attempt to bleach a very dark-coloured feather; there is no bleaching agent known which is sufficiently strong to destroy the colour and at the same time leave the feather intact. All dark-coloured feathers should be put on one side for dyeing in dark shades of browns, blues, greens, or blacks.

Weak acids and acid liquors of a strength such as is employed in dyeing, have little or no action on feathers; in which respects they resemble wool and silk; strong acids disintegrate them, and, therefore, their use in connection with feathers should be avoided.

The caustic alkalies, such as caustic soda or caustic potash, especially when heated, exert a solvent action upon the feather substance; ammonia liquor has, however, comparatively little action; the carbonates of soda or potash have no material effect, they can, therefore, be used for cleansing the feathers from grease and dirt.

**CLEANING FEATHERS.**—The first proceeding will naturally be to free the feathers from the grease they contain; this must be thoroughly done before they can be dyed. Of course, old feathers which have been previously treated do not require so much cleaning as new feathers. For old feathers a liquor may be made from a good sample of soap, heated to about 100° F., and in this the feathers are worked for some time; should they be very dirty they may be left in over night; next they are thoroughly rinsed out with water, when, generally, they will be sufficiently clean. The addition of a little liquor ammonia to the soap liquor will materially facilitate the cleansing of the feathers without injuring them in any way.

New feathers are better cleaned by the following process, which is adapted for 10 lbs. weight of feathers:—Prepare a bath from  $2\frac{1}{2}$  lbs. of soda crystals dissolved in 12 gallons of water; to it add 1 lb. of ammonia; heat this bath in 100° F., immerse the feathers in it for four to five hours, turning them over at intervals; the feathers should next be well washed with water, then treated again to a bath of soda and ammonia, using this a little stronger, and at a temperature of about 140° to 150° F., and the feathers

worked in it for about three hours, after which they may be taken out and well rinsed in water, when they will be ready for any further treatment.

**BLEACHING OF FEATHERS.**—The older feather dyers chiefly employ the sulphur process of bleaching. After cleansing the feathers in the manner just described, they are put into a large cupboard, which may be constructed of wood or, better, of sheet iron, this cupboard being provided with a false perforated bottom about 12 inches above the true bottom of the cupboard. The feathers are hung from rods or placed on perforated shelves inside the cupboard as is considered to be most convenient. Arrangements are made for burning a quantity of sulphur on the bottom of the cupboard, care being, of course, taken that there be no risk of the apparatus being set on fire by so doing. After the sulphur has been lighted the door is closed, and then the cupboard left to itself for twelve hours, after which it is opened and the feathers taken out.

The best bleaching agent for feathers is, however, peroxide of hydrogen, repeated applications of which will destroy the colour of even dark feathers and materially reduce that of black ones. To prepare the bleaching bath, take 1 gallon of the ordinary commercial 10-volume peroxide of hydrogen and dilute it with twice its volume of water; then add sufficient ammonia to render it alkaline to litmus paper. Now enter the feathers, stir them about well until they get thoroughly impregnated with the liquor, and allow them to remain in over night or for twelve hours; then slowly heat the bath to the boil; after which remove the feathers and wash them in clean water. If the feathers are not white enough, then repeat the operation; the same bath will do if it be freshened up with some new peroxide of hydrogen and a little ammonia. The process gives good results as a rule, but feathers may occasionally be met with the natural or acquired colour of which will resist all attempts to remove it.

It may happen that the bath does not appear to bleach well; this may be due to the peroxide of hydrogen having lost strength; to ascertain this point, acidify a little of the bath and add a little permanganate of potash; if the bath be strong, there will be abundant evolution of bubbles of oxygen gas; if the bath be weak, but little gas will form; while if there be no peroxide, no gas is evolved, and the permanganate remains unchanged.

No process of bleaching will give a pure white, and the feathers will always have a more or less yellowish tinge; this may be corrected, and a good white tint obtained by passing them through a bath containing a little Methyl violet B; care

must be taken not to use too much of this dye or the feathers will come up a violet tint, but by using just enough the yellow tone will be corrected and an almost pure white will be the result. This operation is sometimes known as dyeing white.

**DYEING OF FEATHERS.**—This is an operation where a good deal of personal experience gained by long practice is the main element of success. In a book of this description it is not possible to do more than indicate what dyestuffs to use to produce a given effect and some idea of the relative proportions of those dyestuffs, owing to the very varied character of the feathers, and to their different affinities for the dyes, as explained above. The feather dyer must, then, not rely too much upon a recipe, but must be prepared to modify his working according as he sees the feathers are taking up the dye.

1. **Logwood Blacks on Feathers.**—Logwood is the dyestuff which is most used for the purpose of dyeing blacks on feathers, although dyers would do well to pay some attention to the many coal-tar blacks now on the market which are much more easy to use than logwood. Several methods can be followed for producing a black from logwood. In any case it is a matter of some difficulty, and requires the exercise of some care on the part of the dyer.

(a) *Chrome Logwood Black.*—After thoroughly cleansing the feathers they are placed in a bath containing 4 per cent. of the weight of the feathers of bichromate of potash, 4 per cent. of copperas, and 3 per cent. of tartar; in this the feathers are treated at just under the boil for an hour and a-half, when they are taken out, and well rinsed in water; after which they are ready for the dye bath. The latter is made with 10 per cent. of logwood extract, 3 per cent. of fustic extract, and 10 per cent. of soap; in this the feathers are treated at 200° F. until a good black is obtained. Should the operation threaten to take too long, it is advisable to take the feathers out, rinse them, and re-enter them into the first bath for half an hour or so, then to rinse and enter them again into the dye bath. When a full shade is obtained the feathers can be taken out of the dye bath, well rinsed in water and dried. It may happen in dyeing blacks by any process that the stem only acquires a grey shade; in the majority of cases this will be found to be due to some grease being left in the stem, and the remedy is to brush the stems with a weak solution of ammonia before again placing the feathers in the dye bath. Painting the stems with a weak solution of shellac in methylated spirit coloured with Nigrosine is another remedy which may be resorted to.

(b) *Iron-logwood Black*.—Steep over night in a solution of 50 per cent. of soda crystals, next squeeze out all surplus liquor and steep in a bath of nitrate of iron at 15° Tw. for six hours. Next prepare a dye bath with 10 per cent. of logwood extract, 5 per cent. of fustic extract, and 5 per cent. of soap; in this place the feathers and work at a temperature of 180° to 200° F. until the full shade is obtained. By omitting the fustic bluer shades of black are obtained.

(c) *Iron-copper-logwood Black*.—Prepare a bath with 5 per cent. of copperas, 5 per cent. of bluestone, and 5 per cent. of tartar. Work the feathers in this at 200° F. for one to one and a-half hours, then lift and rinse, finally dyeing in a bath of logwood and fustic as before.

2. **Black on Feathers.**—Prepare a dye bath with 8 per cent. of Acid black S, 10 per cent. of Glauber's salt, and 4 per cent. of sulphuric acid; dye the feathers in this at the boil. This has given very good results in the author's hands, and a good black of a bluish tone is obtained; by adding a little Acid yellow a jet shade of black is the result. Some kinds of feathers take this black more easily than others. It is important that the feathers be free from grease and soap.

Other coal tar blacks which may be used as, for example, the Naphthol blacks, Victoria blacks, Azo blacks; these are made in a variety of brands giving various shades of black from a blue to a violet tone; to obtain jet-black shades from them it is necessary to add a little of an Acid yellow or Acid green to the dye bath. With nearly all of them fairly good results are obtained.

3. **Navy Blue on Feathers.**—Prepare a dye bath with 4 ozs. Indazine M, 8 ozs. Glauber's salt, and 1 oz. sulphuric acid; enter the feathers and treat at from 180° F. to 200° F. to shade. Good navy blues are also obtained from Acid black BB, shaded with a little Acid violet. The bluer shades of Naphthol black may also be used for producing navy blues.

4. **Bright Blue on Feathers.**—The dye bath may be prepared with 4 ozs. Soluble blue D and 8 ozs. oxalic acid; enter the feathers and work at 200° F. to shade, then lift, wash, and dry.

5. **Scarlet on Feathers.**—Make a dye bath with 2 ozs. Scarlet 2RJ and 8 ozs. bisulphate of soda; enter the feathers and work at the boil to shade, then lift, wash, and dry. Another method consists in using 2 ozs. Scarlet and 8 ozs. Glauber's salt, working at from 180° to 190° F. to shade. Another plan is to use a dye-bath which contains 2 ozs. Safranine, 1 oz. of Auramine, and 8 ozs. Glauber's salt, working at about 180° F. to shade.

6. Grey on Feathers.—For a silver grey use Induline A dyed in a bath containing a little oxalic acid ; this gives a bluish grey, the depth of which can be varied according to quantity of dyestuff used. A silver grey is best obtained by using a mixture of Nigrosine, Induline, and oxalic acid.

7. Cream on Feathers.—This can be best obtained by adding a little Phosphine to the dye bath.

8. Salmon on Feathers is best obtained by using a little Rhodamine, Auramine, and dyeing in a bath containing a little acetic acid. In the dyeing of cream, salmon, and other light tints care should be taken to use but little dyestuff, the aim being to first obtain a paler shade than what is required, then to add more dyestuff to bring up the desired tint. It is much easier to make a shade darker in this way than it is to reduce a tint when once dyed.

9. Pink on Feathers.—This is best obtained by using Rhodamine with a little acetic acid in the dye bath.

10. Rose on Feathers.—A fine shade can be dyed in a bath containing Azo eosine, Glauber's salt, and a little sulphuric acid.

11. Green on Feathers.—Greens are fairly easily dyed on feathers with any of the brands of aniline greens ; the following hints will, however, be found serviceable :—*(a) Bluish green.*—Use Brilliant green with a little acetic acid in the bath. *(b) Bronze green.*—Prepare the dye bath with a mixture of 1 oz. Ethyl green, 1 oz. Bismarck brown,  $\frac{1}{2}$  oz. Cinereine, and 4 ozs. acetic acid. *(c) Olive green.*—Use 1 oz. Brilliant green, 1 oz. Chrysoidine, and a little acetic acid. *(d) Emerald green.*—Use  $\frac{3}{4}$  oz. Brilliant green, 1 oz. Auramine, and 8 ozs. Glauber's salt. By varying the proportions of the two dyestuffs named, a great variety of shades of green, varying from a very yellowish green to a blue green, can be obtained. *(e) Russian green.*—Use 2 ozs. Azine green TO with a little acetic acid in the dye bath.

12. Browns on Feathers.—Browns can be dyed fairly well with the Bismarck browns which give bright shades. *(a) Seal brown.*—Make the dye bath with 2 ozs. Bismarck brown and 1 oz. Induline B, working at from  $180^{\circ}$  to  $190^{\circ}$  F. to shade. *(b) Olive brown.*—Make the dye bath with Fast brown, Fast red, and Acid blue 4S, adding a little sulphuric acid and working to shade at about  $200^{\circ}$  F. By varying the proportions of the dyestuffs a variety of brown shades may be dyed, from a yellowish brown to a dark walnut brown.

13. **Old Gold on Feathers.**—Make a dye bath with 1 oz. Chrysoidine,  $\frac{1}{2}$  oz. Auramine, and 8 ozs. Glauber's salt.

14. **Sky Blue on Feathers.**—Make the dye bath with a little Patent blue V and a few drops of sulphuric acid, working at about 200° F. to shade.

Generally feathers dye pretty much the same as silk—that is, the same dyestuffs will produce very much the same shades on both silk and feathers, so that any instructions which may have been given for the former fabric are equally applicable for the latter articles.

The method adopted in drying feathers has a very material influence on the appearance of the finished article. To have a good-looking feather it is necessary that the flues or plumes be as open as possible; this cannot always be attained if the feather is simply allowed to dry as it comes from the rinsing waters, as the flues then have a tendency to clog together. It is found in practice that the best method of overcoming this defect is to add a quantity of white starch to the last wash waters, which must be quite cold; put in plenty of starch, then dip the feather, shake it about well so as to get the starch well into the flue of the feather, then allow it to dry; when dry, the starch may be shaken out, leaving the flue of the feather open and full.

**FINISHING FEATHERS.**—After being dyed, feathers require to be passed through some finishing process before they can be sent to the customer. One of these operations is that of curling; this is a simple operation in itself, and yet it is one which requires a little expertness at the hands of the operator. Curling is much easier to do than to describe; it is carried out much in the following manner:—The feathers are first steamed to soften them; this ought to be done with steam which is as free as possible from water; this can be secured by having a fairly capacious kettle built with the spout passing out of the top with a broad base, the kettle not being more than half full, and the spout placed upon the top, so that the steam is as dry as it is possible to get it. The curling is effected by drawing the flues of the feather over the back of a knife which has a curved blade, and the curl is fixed by drying the feather before a fire. A little practice will soon make a proficient curler.

To give flexibility to the feather it is usual to cut away the back portion of the stem; this is an operation which requires some degree of care in carrying out, or otherwise the feather may be damaged. It requires a sharp knife and a steady hand to ensure success.

## CHAPTER VIII.

## GLOVE CLEANING AND DYEING.

THE particular kind of gloves dealt with in this chapter are those made from kid and other leathers; for, although gloves are made from silk and other materials, such rarely come into the dyer's hands, and when they do they can be treated according to the character of the materials from which they are made.

The cleaning of kid or leather gloves of any kind is by no means a difficult operation, although, of course, it must be carefully done.

**CLEANING GLOVES.**—To clean and dye gloves to perfection they should be placed upon a wooden glove tree and kept upon that throughout the whole of the operations, and until they get fairly dry; this prevents them from shrinking to any considerable extent. Some dyers clean gloves when placed upon their own hands, but it is obvious that by adopting such means they have not that facility of movement that they have when the glove is stretched upon a proper glove tree. The first proceeding will be to brush the glove well so as to free it from loose dirt. Then the next must be to free it from grease and stains of various kinds. For this purpose several methods are available.

(a) Dip the gloves in clean warm water for a few minutes, rub them well with a sponge and soap and water, to which a little ammonia has been added, rinse off in clean warm water, rub with a soft dry cloth until nearly dry, then take off the tree and allow to dry slowly in the air.

.. (b) Lengthy immersion in a little weak ammonia often loosens and removes the grease, so that subsequent rinsing in clean warm water will complete the operation.

(c) Another plan is to make a pasty mixture of Fuller's earth, calcined magnesia, and water, and with this rub over the glove; allow to dry, which it will do quickly; then brush off with a soft brush, when probably the grease stains will have disappeared and the glove be cleaned.

(d) In the case of kid, chamois, and some other soft gloves, it is desirable to avoid the use of water, so as to run no risk of

shrinking, which would take place were a watery treatment adopted. In such cases the gloves may be stretched on the hand or tree, then dip them below the surface of some benzoline or benzene contained in a basin, sponge them or rub them over very well ; the spirit dissolves out all the grease, and leaves the glove clean ; a short exposure to the air will be sufficient to get rid of the spirit still attached to the glove.

Milk, mixtures of milk and soap, or of milk, soap, and yolk of egg have been used for cleaning gloves, but there is no advantage in such over the methods enumerated above.

If the gloves are white gloves, it is advisable to rub them over with pipe clay to whiten them. Suede and tan gloves may be finished as described below.

**DYEING GLOVES.**—The dyeing or colouring of gloves is done by simply brushing them over with a solution of the required colouring matter, there being usually sufficient affinity between the animal substance of the glove and the colouring matter used as to firmly fix the latter. The best class of dyestuffs to use is the basic coal-tar dyes like Magenta, Safranine, Phosphine, &c. These have so strong an affinity for animal tissues that simply brushing leather over with an aqueous solution is sufficient to colour or stain the leather. Next to these in their value as dyes for leather are the azo and acid dyestuffs ; these require the aqueous solutions to be acidified with some acid, best with acetic or oxalic acid. The mordant dyes, such as Alizarine, logwood, fustic, are not so serviceable, although they are used in the dyeing or staining of leather. The following recipes will give all necessary details :—

1. **Black on Gloves.**—(a) *From Logwood.*—The most common method of dyeing or staining leather in black is by means of logwood, developing the colour by means of an iron salt. First brush the glove over with a decoction of logwood at 5° to 6° Tw., giving two or three coatings. It is desirable to use weak liquors and to go over the gloves two or three times, rather than to use a strong liquor and attempt to obtain the desired effect at one operation ; greater uniformity or evenness of shade is thereby obtained, and this is a most important feature in staining leather. The same remark applies to the staining of leather in all colours. After brushing with the logwood extract go over the gloves with a weak solution of copperas (sulphate of iron), repeating the process until the desired black shade is obtained. It is a good plan to go over the gloves alternately with the logwood and iron solutions ; thus,

as it were, building up the black to the desired depth. This method will give a bluish shade; if more jet shade be desired then a little fustic may be added to the logwood decoction. In place of using copperas, nitrate of iron may be employed. A mixture of copperas and bluestone also gives a good black. With care excellent results may thus be obtained.

(b) *From Coal-Tar Blacks.*—The leather dyer has at his disposal many coal-tar blacks which may be used in the staining of leather with excellent results, and in a much more simple manner than is possible when logwood is used. The following hints will be found useful in the application of these blacks, it being premised that they are employed by brushing the gloves or other leather articles with a weak solution of the particular dyestuff which is being used, going over the article several times to ensure evenness of tint. Under the names of Leather black, Spirit black, Brilliant black, are sold black dyes which are only soluble in methylated spirit; these blacks produce some very fine shades of black on leather without any difficulty, and the glove dyer will do well to give them some attention. The Acid blacks, Naphthol blacks, Victoria and Wool blacks can also be used with good effect; they are dissolved in water and to the solution a little oxalic acid is added. To fully develop a black will require several applications, while, if a jet black is to be obtained, it may be advisable to add a little Acid yellow or Acid green to the solution, as these blacks give from violet to blue-black tones. The bluish-black tone, so much desired in kid gloves, is best imitated by means of these coal-tar blacks.

2. **Brown on Gloves.**—Prepare a decoction from a mixture of fustic, a little logwood, and Brazil wood; brush this over the gloves, then develop the brown by brushing over with a solution of copperas. A variety of shades may be obtained by varying the proportion of the dyestuffs. The best and easiest way of producing browns is by brushing the gloves with a solution of Bismarck brown R if a red shade of brown is desired; if a seal brown is needed, add a little Nigrosine; if an olive brown, a little Brilliant green with some Nigrosine; if a walnut brown, add some Induline and Magenta. The Benzo browns also give some good shades on leather.

3. **Crimson on Gloves** is best got with a mixture of Safranine and Magenta. Amaranth, to which a little oxalic acid has been added, also gives good results.

4. **Scarlet on Gloves.**—Use a solution of Safranine to which

has been added sufficient Auramine to turn the colour scarlet. The Azo Scarlets also give good shades on leather.

5. **Claret on Gloves.**—Use a solution of Union Fast Claret or a solution of Bordeaux BL, to which a little oxalic acid has been added.

6. **Yellow on Gloves** is rarely wanted, but any of the coal-tar yellows, such as Auramine, Thioflavine, or Naphthol yellow gives good results.

7. **Grey on Gloves.**—Fine shades of grey are obtained by using weak solutions of Nigrosine or of Induline, the former giving browner tints than the latter, which gives blue greys. A weak sumach liquor, followed by a weak iron liquor, will also dye a grey.

8. **Greens on Gloves.**—These are best obtained from the coal-tar dyes. Brilliant green gives very bright shades; mixed with a little Bismarck brown olive greens are obtained; with Chrysoidine and a little Induline, dark Bottle or Russian greens can be obtained. Bronze greens can be got by mixing the green with Bismarck brown and a little Safranine; Peacock greens by adding a little Soluble blue; Grass greens by mixing the green with Auramine.

9. **Blues on Gloves.**—Almost any shade of blue, from the palest sky tints to the deepest shades, may be obtained by using a solution of Soluble blue of varying degrees of strength, according to the tint required.

10. **Cream on Gloves** is best obtained by using Phosphine.

11. **Straw Colour on Gloves** can be obtained by using a weak solution of Naphthol yellow or Acid yellow; the addition of a little Chrysoidine will give brownish shades of straw.

The glove dyer will find that the above hints will serve him in good stead for almost, if not quite, all the shades he will have to dye. For further information reference may be made to a series of articles which appeared in *The Dyer and Calico Printer* for 1893 on Leather Dyeing and Staining.

After the gloves have been cleaned or dyed by any of the processes which have been described above they must undergo a finishing process before they can be sent home to the customer, the object being to make the gloves supple and soft, and the colours bright. The gloves, after being coloured, should be well rinsed in clean, warm water; then rubbed as dry as possible with a soft cloth; after which they may be rubbed over with a mixture of yolk of egg, olive oil, and milk, which at once softens the leather and brightens the colours.

## CHAPTER IX.

## STRAW BLEACHING AND DYEING.

THE bleaching, dyeing, and staining of straw is now a very important branch of the art of the bleacher and dyer, both of new goods and of old ones which the owner may require renovating. It will, therefore, be worth while to devote some space to the consideration of the best methods of bleaching, dyeing, staining, and finishing of this class of goods.

The straw is invariably treated in one of two forms, either in that of a plait or when made up into hats, bonnets, &c. So far as the chemistry of the subject is concerned—that is, in the materials which are used in any of the processes—there is no essential difficulty involved in treating either form; it is only in the mechanical treatment, due to the difference in the form of the material which is being dealt with, that there are some modifications in the manner of carrying out the work.

Straw is a vegetable production, like cotton, linen, jute, &c.; but, unlike those fibres, its constitution causes it to offer some special difficulties in the way of the dyer obtaining a successful result; this appears to be largely due to the peculiar external coating of the straw, which contains a large proportion of siliceous or other mineral matter, which prevents liquids from penetrating readily into the centre, and possesses little affinity for colouring matters.

Straw contains naturally some yellow colouring matter, which has a rather considerable affinity for the fibre, so that it is with difficulty removed by any process of bleaching; some straws are more troublesome in this respect than others.

**BLEACHING OF STRAW.**—To bleach straw to a perfect white is at present a practical impossibility; at the most but a creamy white is the result. Several methods are available; the most common one in use in straw bleaching is the sulphur plan.

*Sulphur Process of Straw Bleaching.*—To carry this out a chamber is built, which may be of any size that is convenient for the amount of work that is done; this chamber should be provided with wooden racks, on which the hats may be placed or the bundles of straw plait hung. On the bottom of the

chamber is placed a pan of sulphur, which is set on fire; the chamber is closed up and left to itself for ten to twelve hours; after which the door of the chamber is opened and the goods removed. Generally, they will be found of a fair white. A perforated false bottom should be placed between the pot of burning sulphur and the goods to prevent particles of unburnt sulphur from settling on the goods placed at the bottom of the chamber and turning them yellow. The active agent in this process of bleaching is the sulphur dioxide gas produced during the combustion of the sulphur; this acts upon the colouring matter in straw and converts it into a colourless product; the colouring matter is not actually destroyed, for by washing with soap and weak alkalies it is restored. This is one defect of the sulphur process of bleaching.

Instead of employing the sulphur dioxide in a gaseous form, which presents some disadvantages, it may be employed in a liquid form; by compression sulphur dioxide can be converted into a liquid, and it is supplied commercially in this form in siphons and cylinders. By opening the valve of these vessels the dioxide can be liberated in the gaseous state, and on passing this gas into cold water a solution is obtained which may be employed as a bleaching bath, the straw goods being immersed in this bath until they have acquired a satisfactory colour.

Another plan sometimes adopted is to immerse the straw in a solution of sodium bisulphite for a few hours, to pass it through a bath containing a little hydrochloric acid, and then washing it thoroughly with water.

The bleaching properties of peroxide of hydrogen or of peroxide of sodium may be taken advantage of, although these are not very strong. When working with these bleaching agents it is best to give the straw a preliminary boil in a weak soda lye; then to immerse it in a bath made with 1 gallon of peroxide of hydrogen and 3 gallons of water, to which a little ammonia has been added to make it faintly alkaline. The straw is immersed in this for twelve hours, and then washed. A repetition of the process may be necessary.

The author has found that a good plan for bleaching straw is to boil it in a solution of about 2 per cent. of sodium peroxide, rinse it in acidulated water, pass it through a bath of bisulphite of soda, and finally to well wash it with water.

It has been recommended to pass the straw first through a bath of potassium permanganate, and then through one of bisulphite of soda, but the author has never found this plan very successful.

**DYEING OF STRAW.**—Before straw is dyed it is advisable to give it a boil in a bath of soda ash, using about 2 per cent. of the weight of the straw of the alkali. This softens the crust of the straw and renders it more susceptible to the dyestuff. After boiling it in the alkali it should be rinsed in clean water, when it is ready for the dye bath.

Straw seems to be peculiar in its behaviour with dyestuffs, so that no very general principles can be laid down as to methods of dyeing in the absence of definite information bearing on this point. In the recipes which follow, the best methods of dyeing straw will be given; carefully carried out they will, in the main, be found successful; still, the straw dyer must be prepared to meet occasionally with failures; in such an event he must try some other plan of attaining his end than the one he has been following.

The recipes here given are calculated to be for 10 lbs. of straw, no matter in what form.

1. **Jet Black on Straw.**—Lay down, over night, in a boiling bath of 2 ozs. soda to 1 gallon of water, using enough to comfortably work the straw in. Lift next morning and drain. Prepare a bath with 7 lbs. logwood and 2 lbs. fustic; enter the straw in this and work at the boil for one hour; then lift, allow to drain, and lay down the straw in a bath of 1 lb. copperas for four to five hours; after which expose to the air for two hours, then wash and dry.

2. **Blue on Straw.**—Prepare a decoction of 2 lbs. sumach; work the straw in this at the boil for two hours; then allow to steep over night; next day, drain and enter into a bath of 1 oz. Alkali blue 2B, working at the boil for an hour; then lift, enter into a cold bath of  $\frac{1}{2}$  lb. copperas, and allow to steep for three to four hours; after which rinse and dry.

3. **Dark Navy Blue on Straw.**—Work for two hours at the boil in a bath of  $\frac{1}{2}$  lb. copperas; after which rinse and enter into a bath of  $1\frac{1}{2}$  ozs. Malachite green and  $1\frac{1}{2}$  ozs. Methyl violet 2B, working for an hour at the boil; then pass into a bath of  $\frac{1}{2}$  lb. of logwood for three-quarters to one hour at the boil; after which wash and dry.

4. **Navy Blue on Straw.**—Work the straw in a bath of soda as given in the first recipe; then, after rinsing, pass into a bath containing 1 oz. Methyl violet 3B and 1 oz. tartar, working for one hour at the boil; next pass into a bath of  $1\frac{1}{2}$  lbs. logwood for an hour at the boil, saddening by a bath of  $\frac{1}{4}$  lb. of copperas, after which the straw may be washed and dried.

**5. Dark Blue on Straw.**—Prepare a bath of 2 lbs. sumach and work the straw in this for two to three hours at the boil; then lift, and drain, then pass the straw into a bath of 1 oz. Soluble blue 2B, in which the straw is worked at the boil until the full shade is obtained; lastly, the straw is passed into a bath of a  $\frac{1}{4}$  lb. copperas to darken the colour; rinsed and dried.

**6. Light Stone on Straw.**—Make a dye bath with 5 ozs. tartaric acid, 5 ozs. bisulphate of soda, 9 ozs. ammoniacal cochineal, 4 ozs. indigo extract, and  $1\frac{1}{4}$  ozs. turmeric. Enter the straw into this bath at about  $180^{\circ}$  F., then raise to the boil and work for one and a-half hours; after which rinse and dry.

**7. Pale Gold Brown on Straw.**—Boil the straw for half an hour in a bath containing 7 ozs. turmeric; add to the same bath 1 oz. Bismarck brown GG, and a little Brilliant green, working for half an hour longer; then lift, wash, and dry.

**8. Mode Brown on Straw.**—Prepare a boiling bath of 1 lb. soda; allow the straw to steep in this over night; next day pass into a bath of 4 ozs. archil and 2 ozs. tartar; work in this bath at the boil for one hour; then lift, add to the same bath  $\frac{1}{2}$  lb. copperas, re-enter the straw, and work until the shade is obtained.

**9. Brown on Straw.**—Make a dye bath with 7 ozs. fustic, 1 oz. alum, 3 ozs. Bismarck brown R, a little Induline B and Green crystals A. Work the straw in this to shade; then lift, wash, and dry.

**10. Brown on Straw.**—First boil the straw in a bath of 1 lb. soda, allow to steep in the same bath for five to six hours or over night; pass into a bath of 1 lb. of copperas, working for one hour at the ordinary temperature; then lift. If a darker shade of brown is required than is yielded by this method pass the straw into a bath of Induline.

**11. Beige on Straw.**—Boil the straw in a bath containing 1 lb. Glauber's salt and 6 ozs. tartaric acid for half an hour; then add to the bath  $\frac{1}{2}$  oz. cochineal,  $\frac{1}{2}$  oz. indigo extract, and  $\frac{1}{2}$  oz. Orange G, working for half an hour longer at the boil.

**12. Dark Brown on Straw.**—Make a bath with 4 lbs. copperas and 2 lbs. sumach; work the straw in this for two hours at the boil; then lift, rinse, and pass into another dye bath made with 6 lbs. peachwood, 2 lbs. logwood, and 1 lb. fustic, working at the boil for one hour.

**13. Bright Brown on Straw.**—Prepare a decoction of 2 lbs. fustic; boil the straw in this for half an hour; add to the same

bath 4 ozs. Bismarck brown R, with a little Green crystals A to shade; work the straw for about half an hour at the boil to shade.

14. Leaf Yellow on Straw.—Make a bath with  $7\frac{1}{2}$  ozs. tartaric acid,  $1\frac{1}{4}$  ozs. turmeric, and 5 ozs. ammoniacal cochineal, working at the boil to shade.

15. Grey on Straw.—Make a dye bath with 6 ozs. tartaric acid, 3 ozs. indigo extract, and 4 ozs. ammoniacal cochineal, working at the boil for an hour; then lift, wash, and dry.

16. Pale Violet on Straw.—Make a bath with 7 ozs. tartaric acid and 7 ozs. alum; work the straw in this at the boil for half an hour; then lift the straw, add to the bath  $\frac{1}{4}$  oz. cochineal and a little Methyl violet R, working at the boil to shade after re-entering the straw.

17. Cardinal on Straw.—Boil the straw in a bath of 7 ozs. tartaric acid for half an hour; then add to the same bath 1 oz. Auramine and 4 ozs. Safranine Prima, working at the boil until the straw is dyed the full shade.

18. Fawn Red on Straw.—Boil out the straw with tartaric acid as in the last recipe; then add to the bath 1 oz. Bismarck brown R and  $\frac{1}{2}$  oz. Safranine Prima, working at the boil to shade; then lift, wash, and dry.

19. Mode Pink on Straw.—Boil the straw in a bath of  $\frac{1}{2}$  lb. gall, 1 lb. archil liquor, and  $\frac{1}{2}$  lb. tartar to shade.

20. Greenish on Straw.—Boil with tartaric acid as in one of the above recipes; then add to the same bath  $\frac{1}{2}$  oz. Thioflavine T and sufficient Brilliant green to shade; work at the boil until the straw is dyed.

21. Myrtle Green on Straw.—Prepare a dye bath with 9 ozs. fustic, 4 ozs. indigo extract, 1 oz. Bismarck brown R, a little Induline A, and a little Green crystals A, working at the boil to shade.

22. Pea Green on Straw.—Prepare a bath with 1 lb. fustic, 4 ozs. indigo extract, and 4 ozs. alum, working at the boil to shade.

23. Bottle Green on Straw.—Steep the straw in a bath of 1 lb. soda over night; next, boil in a bath of  $\frac{1}{2}$  lb. bichromate of potash and 3 ozs. tartar for one hour; rinse, and enter into a fresh bath of  $1\frac{1}{4}$  lbs. logwood and 2 lbs. fustic, boiling for one and a-half hours; then lift and enter into a bath of  $\frac{1}{4}$  oz. Brilliant

green, and work at a hand heat to shade. Sadden, if necessary, with copperas.

**24. Dark Green on Straw.**—Boil for one hour in a bath of 2 lbs. fustic and 1 lb. sumach; then work for half an hour in a bath of 2 lbs. iron liquor; lift, rinse, and dye in a new bath containing 2 ozs. Malachite green, working at about 200° F. to shade.

Instead of dyeing the straw by any of the recipes given above, the straw might be painted; for this purpose, and to give the straw a gloss at the same time, it is best to make use of a substratum of a weak shellac varnish, colouring this with any of the aniline dyes to shade. For blacks, what is known as Spirit black will be found to answer very well; for browns, a mixture of Bismarck brown, Induline, and Brilliant green may be employed; the proportion of the ingredients being varied according to the shade desired.

For reds there may be used Magenta, Safranine Prima, Claret red, shading with Auramine. For yellows, Auramine gives good results. For blues, Induline, Soluble blue, and Methylene blue may be applied. For greens, Brilliant green and Azine green; and so on.

Obviously, by this method of working, only the surface of the outside of the hats or other straw goods will be coloured; still this is not an insuperable objection in most cases, while darker and more solid looking shades can be obtained by this means than is possible with the other method of working. Should it be found that the orange or brownish colour of the shellac interferes too much with the tint of any bright shades which it is desired to produce by this means, then the shellac varnish may be replaced by a varnish made from gum sandarac and gum mastic with methylated spirit, such a varnish having a white or only a pale straw colour. Varnishes made with turpentine or benzene are useless for this purpose, inasmuch as they will not dissolve any of the colouring matter or dyestuff employed.

The finishing of dyed straw either in a plait form or made up is a comparatively simple matter. Straw goods painted or stained do not require any further treatment. Dyed straws require to be well washed in water, then dried, and polished; which latter operation is usually done in the made up form. The polish may be imparted by friction, or by varnishing, using for this purpose a white spirit varnish, such as can be made from gum sandarac, gum mastic, Manila copal, or other white gums, but a thin coating is needful.

## APPENDIX A.

## A DICTIONARY OF DYER'S DRUGS AND DYEWARES.

THIS dictionary does not profess to be a complete account of the whole of the drugs, dyes, and dyewares which are in use in the dyeing of textile fabrics ; it includes those only which are in common use among garment dyers. None of the aniline dyes are mentioned, for which the reader is referred to the author's *Dictionary of Coal-Tar Colours*, or to Knecht, Rawson and Loewenthal's *Manual of Dyeing* ; the last named work may also be consulted for fuller descriptions of the materials used in dyeing.

**Acetate of Alumina.**—This compound has the chemical formula  $\text{Al}_2\text{C}_2\text{H}_3\text{O}_2$ . It is largely used as a mordanting agent for cotton which is to be dyed with Alizarine and similar dyestuffs. It is prepared and sold in the form of solutions of 1·08 (16° Tw.) specific gravity, and containing 2·25 to 2·5 per cent. of alumina,  $\text{Al}_2\text{O}_3$ . The usual method of preparation is to mix solutions of alum or alumina sulphate with solutions of lead or calcium acetates ; the precipitate of lead or calcium sulphate is allowed to settle out, the clear liquor being used. It may also be prepared by dissolving freshly-precipitated alumina in acetic acid, which is the best method of obtaining it pure. Acetate of alumina forms the main constituent of the commercial *red liquors*, which see.

**Acetate of Chromium.**—This substance, which has the chemical formula  $\text{Cr}_2\text{C}_2\text{H}_3\text{O}_2$ , is prepared from chrome alum by precipitating its solutions with either acetate of lead or acetate of lime, and using the clear liquor. It may also be obtained by dissolving freshly-precipitated chromium oxide in acetic acid. It can be obtained in a solid form, but is usually sold in the form of solution, which has a dark green colour, and a specific gravity of 1·160 (32° Tw.). It is chiefly used as a mordant in printing and dyeing cotton, and in silk dyeing, with the alizarine group of dyestuffs.

**Acetate of Lead,** commonly known as "sugar of lead."—It has a composition corresponding to the formula  $\text{Pb}_2\text{C}_2\text{H}_3\text{O}_2$ . When pure, it forms large transparent crystals, easily soluble in water, and having a sweet metallic taste. It is prepared by

dissolving litharge, the monoxide of lead, in acetic acid, and crystallising out the salt which is formed. Sugar of lead, to give it its commercial name, is sold in two forms, "brown sugar of lead" and "white sugar of lead," the former being made when litharge is dissolved in crude pyroligneous acid; the latter when ordinary acetic acid is employed in its preparation. Acetate of lead contains 68·61 per cent. of lead oxide, and 31·39 per cent. of acetic anhydride. In dyeing it is used in the production of chrome oranges, and for making acetates of alumina and chromium.

**Acetate of Lime** has a composition corresponding to the formula  $\text{Ca}_2\text{C}_2\text{H}_3\text{O}_2$ . It is sold in two forms, "brown acetate of lime" made from pyroligneous acid and lime; and "grey acetate of lime," which is made from ordinary acetic acid and lime. It is used in the preparation of alumina and chrome acetates and in calico-printing in connection with Alizarine.

**Acetic Acid** is obtained by the dry distillation of wood and by fermentation of alcoholic liquors. The crude acid obtained from wood is of a dark colour, and has a very peculiar tarry odour, owing to the presence of a number of volatile organic compounds. It is generally known under the name of pyroligneous acid. Acetic acid is a water-white liquid, having a strong and characteristic acid odour and sour taste. The strongest commercial acid will in winter set into a solid, ice-like mass, and is hence known as *glacial acetic acid*. This has a specific gravity of 1·058 (11·6° Tw.), and contains nearly 99 per cent. of real acetic acid.

*Strong acetic acid* has a specific gravity of 1·050 to 1·052 (10° Tw.), and contains about 40 per cent. of real acetic acid. A weaker quality is also made of 1·035 to 1·040 (7° to 8° Tw.), containing 25 per cent. of real acetic acid.

**Albumen**, the principal constituent of white of egg and of the serum of blood, is a nitrogenous, organic body of highly complex constitution. In the textile colouring industries it is principally used in calico-printing for the purpose of fixing pigment colours. The white of an egg is occasionally used in the finishing of straw hats, and other articles of wearing apparel, to give them a gloss.

**Alizarine red oil.**—See *Soluble oil*.

**Alum**, the crystallised double sulphate of alumina and potash, having the formula  $\text{K}_2\text{Al}_2\text{SO}_4 \cdot 24\text{H}_2\text{O}$ , is a most valuable mordant, and is extensively used by all classes of dyers. It occurs in large, transparent, octahedral crystals, having the following composition:—Alumina,  $\text{Al}_2\text{O}_3$ , 10·84 per cent.; potash,

$K_2O$ , 9.91 per cent.; sulphur trioxide,  $SO_3$ , 33.73 per cent.; water,  $H_2O$ , 45.52 per cent. It dissolves in ten times its volume of water at ordinary temperatures, and in an equal weight at the boiling point. For dyeing purposes it ought to be free from iron, the presence of which causes shades dyed with the aid of alum to become dull. The presence of iron can be detected by adding a little hydrochloric acid and a few drops of a solution of potassium ferrocyanide; a blue colour shows the presence of iron.

Sometimes the ammonia alum, which contains 11.35 per cent. of alumina, is substituted for the above potash alum. Both alums have identical properties.

**Ammonia**, the liquor ammoniæ of the shops, was originally obtained by the dry distillation of horns and bones, but now its chief source is the ammoniacal liquor of the gas works, from which it is recovered by distillation with lime. It is essentially a solution of ammonia gas, a compound of nitrogen and hydrogen, in water. It is, when pure, a water-white, transparent liquid, having a specific gravity of 0.891; it has a pungent and very characteristic odour. It has a strong alkaline reaction and will combine with all acids, producing what are known as the ammonium salts, many of which find extensive application in dyeing. Liquor ammoniæ contains about 32.5 per cent. of ammonia gas. Although of an alkaline character, neutralising acids and saponifying fats, yet it has no action upon textile fibres, especially on wool and silk; hence it is largely employed in the cleaning of wool and silk goods, which would be destroyed were soda or potash employed in its place.

**Annatto**, variously spelled annotta, arnotto, is the pulpy juice of the seeds of the *Bixa orellana*, a plant which is a native of Central America, and cultivated very largely in some of the countries of that region. It is used chiefly in the dyeing of silk, although its use for this purpose has, with the advent of the coal-tar colours, become more or less obsolete. It requires alumina or tin mordants to fix the dyestuff on the fibre.

**Aqua fortis**, once a common name for nitric acid; what was known as *single* aqua fortis had a specific gravity of 1.160 ( $32^\circ$  Tw.), while *double* aqua fortis had a specific gravity of 1.320 ( $64^\circ$  Tw.).

**Archil**, a red liquor prepared from orchella weed. The weed is treated with a solution of ammonia, and the liquor so obtained is allowed to ferment for some weeks, when it gradually acquires a red colour. It is largely employed in the dyeing of wool and silk, on account of the fact that it produces very level shades,

possessing a fair degree of fastness to washing; it also unites very readily with other dyestuffs to produce various useful compound shades. Its place is now being largely taken by so-called Archil substitutes prepared from coal tar.

**Argol**, the crude acid tartrate of potash deposited during the process of fermenting grape juice in the manufacture of wine. It is chiefly used in the dyeing of wool for the purpose of assisting the deposition of the mordanting material on the fibre.

**Bark Liquor**, a decoction of quercitron bark, usually sold at strengths ranging from 8° to 12° Tw.

**Barwood**, one of the red dyewoods, is obtained from the *Baphia nitida*, a tree grown very extensively in the Sierra Leone district of West Africa. The colouring principle of this wood belongs to the insoluble class, comprising those natural colouring matters which are but sparingly soluble in water; the consequence is that when barwood is used in dyeing, the wood is added directly to the dye bath in a rasped condition. Decoctions or extracts of barwood cannot be prepared. Barwood with tin and alumina mordants yields very bright red shades of a fair degree of fastness to washing.

**Barwood Spirits**, the name given to a solution of tin in a mixture of nitric and hydrochloric acid, at one time largely employed in dyeing reds on cotton with barwood.

**Benzol** or **Benzene**, the lightest hydrocarbon liquid obtained by the distillation of coal tar. It is a limpid, water-white liquid, having a specific gravity of 0·8, and boiling at 80° C.; it has the formula  $C_6H_6$ . See also p. 27 *et seq.* for its uses in garment cleaning.

**Benzoline** or **Benzine**, one of the lightest portions obtained during the refining of American Petroleum and Scotch Shale oil; for its properties, &c., see p. 28.

**Bichrome**, the common name of potassium bichromate, a compound of chromic acid and potash, having the formula  $K_2Cr_2O_7$ . It is sold in the form of orange coloured crystals containing 68·14 per cent. of chromic acid. It is soluble in about twelve times its own weight of water at the ordinary temperature or in an equal weight at the boiling point. It is much used in dyeing, in mordanting wool for dyeing with logwood, fustic, and other mordant colours, in the production of aniline blacks, logwood blacks, &c., on cotton, and it serves as the source for the preparation of other chromium compounds. Of late bichromate of soda has come largely into use in the place of the potash salt, it has the advantage of being cheaper and more soluble in water, requiring about its own weight at the ordinary temperatures

and half its weight at the boiling point; on the other hand, not being a readily crystallisable salt, it is liable to be more impure than the potash salt, while some users have thought that when used in wool dyeing it has a tendency to make the wool somewhat harsh.

**Bisulphite of Soda** has the formula  $\text{NaHSO}_4$ . It can be obtained in the solid form, but for dyer's use it is chiefly sold in the form of a water-white liquid, smelling very strongly of sulphur dioxide. This solution usually has a specific gravity of 1.260 (52° Tw.), which should contain 20 per cent. of sulphur dioxide, upon the proportion of which its value in dyeing depends. It is used in preparing indigo vats, in bleaching wool and silk, and in preparing discharge colours with zinc in textile printing.

**Black Liquor**, an impure acetate of iron, made from pyroligneous acid and scrap iron. It usually has a specific gravity of 1.110 (22° Tw.) and contains from 3.75 to 4 per cent. of oxide of iron. It is chiefly used for dyeing blacks on cotton with sumach and logwood, and is also employed in calico-printing for producing browns and chocolates. It is sometimes met with adulterated with salt, which for calico printers' use is rather deleterious. It is also called *iron liquor*.

**Bleaching Liquor**, a solution of chloride of lime, prepared by passing chlorine gas into lime water. It has usually a specific gravity of 1.040 (8° Tw.), and contains 7 per cent. of available oxygen. Sometimes called *Chemic*.

**Bleaching Powder**, see *Chloride of Lime*.

**Blue Spirits**, a solution of tin in hydrochloric acid, consists mostly of stannous chloride, and usually has a specific gravity of 1.560 (112° Tw.); it contains 42 per cent. of stannous chloride. It is not so much used now as formerly.

**Bluestone**, blue vitriol, common names for *Copper Sulphate*, which see.

**Brimstone**, common name for *Sulphur*.

**British Gum**, common name for *Dextrine*.

**Camwood** is a similar wood to Barwood, and comes from the west coast of Africa. Its colouring principle is but sparingly soluble in water, and hence camwood, like barwood, is added direct to the dye bath. It yields very bright reds which are fairly fast.

**Carbolic Acid**—chemical name, phenol— $\text{C}_6\text{H}_5\text{OH}$ , is one of the substances found in coal tar. It is largely used as a disinfectant, and is of some service in dyeing as a source of dyestuffs, and also as a developer in the diazo method of dyeing.

**Carbon Bisulphide**, a compound of carbon and sulphur, having the formula  $\text{CS}_2$ . It is liquid, colourless, and transparent, and has a strong refracting power. Specific gravity 1.293, and boiling point 46° C. It is very inflammable, burning with a bluish flame, with evolution of sulphur dioxide and carbonic acid gases. The commercial article has a peculiar and unpleasant odour, but the odour of pure bisulphide is not unpleasant. It is a powerful solvent of fats and oils, and hence is used in extracting those substances from wool, &c.

**Catechu**, a tannin substance extracted from various species of *Mimosa* trees, which are grown extensively in India. It comes into the produce markets of this country chiefly under the name of gambier in two forms—in small cubes of about 1 to 1½ inch side, known as "cube gambier," and in large masses, "bale gambier." The former variety is the catechu or yellow catechu of the druggist, and is the variety mostly used in dyeing. Bale gambier is mostly used by leather tanners. It contains from 40 to 50 per cent. of tannin.

**Caustic Potash**, the commercial name of potassium hydroxide, KOH, is prepared from pearl ash by causticising with lime. It is sold, chiefly in the solid state, in three grades of purity, containing respectively 70 to 75 per cent., 75 to 80 per cent., and 80 to 85 per cent. of actual hydroxide. Of recent years, improvements in the methods of manufacture have enabled the makers to produce purer qualities than these. It is chiefly used in the preparation of soft soaps.

**Caustic Soda**, the commercial name of sodium hydroxide, NaOH, is prepared by causticising soda ash with lime. It is sold in the form of a solution, having a specific gravity of about 1.350 (70° Tw.), and containing about 35 per cent. of actual hydroxide; as also in a solid form, of various degrees of purity, which in the alkali trade is measured by the amount of sodium oxide,  $\text{Na}_2\text{O}$ , the sample contains. The chief grades are 60, 64, 70, 74, and 77 per cent., the latter being nearly pure, 77 per cent. of sodium oxide corresponding to 99 per cent. of sodium hydroxide; this quality is also sold under the name of 98 per cent. caustic soda. Caustic soda is largely used in making the hard soaps, bleaching, and in dyeing.

**Chemic**, a term applied to a solution of bleaching powder.

**Chloride of Lime or Bleaching Powder**, a compound made by passing chlorine gas over dry slaked lime, consists principally of calcium hypochlorite,  $\text{CaClO}$ ; it usually contains 35 to 36 per cent. of chlorine, that is available for bleaching purposes. It is used in the bleaching of cotton and other vegetable fibres, for

which purpose it is dissolved in water, the clear solution having a specific gravity of  $1^{\circ}$  to  $1\frac{1}{2}^{\circ}$  Tw.

**Chloride of Zinc**, a compound of zinc with chlorine, having the formula  $ZnCl_2$ . It is made by dissolving zinc in hydrochloric acid, and boiling down the solution until it solidifies. It is, however, chiefly sold in the form of an aqueous solution, having a specific gravity of  $1\cdot 500$  to  $1\cdot 510$  ( $100^{\circ}$  to  $102^{\circ}$  Tw.), and containing 50 per cent. of actual chloride. It is chiefly used in the finishing of cotton cloths as an antiseptic to prevent the formation of mildew.

**Chrome Alum** is the double sulphate of chromium and potassium, analogous to ordinary alum in composition, but containing chromium in the place of aluminium, its formula is  $Cr_2K_24SO_4 \cdot 24H_2O$ . It contains 14·31 per cent. of oxide of chromium. It is used in the mordanting of wool and silk, and also in the preparation of other chromium mordants.

**Cochineal** is the dried remains of the females of a species of the insect family *Coccidae*, the *Coccus cacti*, a native of the West Indies and Mexico, where it is cultivated. The insects feed upon the leaves of the cactus plants, from which they are collected, killed by immersion in boiling water, then dried and exported into this country. Cochineal was at one time largely used in conjunction with tin mordants in the dyeing of fast scarlets on wool and silk, but of late its place has been taken by coal-tar scarlets. It is used in the manufacture of carmine and crimson lakes.

**Copperas**, the common name for ferrous or iron sulphate.

**Copper Sulphate**, also known as bluestone and blue vitriol, is the sulphate of the metal copper, sold in blue crystals having the formula  $CuSO_4 \cdot 5H_2O$ , and containing 63·91 per cent. of actual sulphate. It is used chiefly in dyeing in the production of blacks and dark shades from logwood, fustic, and other natural colouring matters; with logwood, it gives a somewhat greenish tone of black; with fustic, olive shades of green.

**Crystal Carbonate or Crystal Soda**, a monohydrate sodium carbonate having the formula  $Na_2CO_3 \cdot H_2O$ , contains 82 per cent. of actual sodium carbonate, and 18 per cent. of water. It is now largely used in the place of soda crystals, being much stronger and usually purer than they are.

**Cudbear**, a preparation from orchella weed, the weed is thrown into vats with a little ammonia, and there allowed to ferment for some time, being turned over at intervals; the material soon acquires a violet colour; when the operation is considered to be finished the product is dried, and then forms

the commercial product, cudbear. It is used very largely in dyeing on account of its giving very level, uniform shades without very much trouble; in garment dyeing it is very largely used as its affinity for the fibre is such that it dyes faded and unfaded places fairly even; the dyer says it "covers well," while the shades it dyes have a good power of resisting washing, and are fairly fast to light. The colouring matter of cudbear is the same as that of archil.

**Cutch** is an extract from the leaves and small twigs of the *Acacia catechu*, a tree found growing largely in Burmah, whence cutch is exported to this country in large quantities. Besides tannic acid, which gives it value in the tanning of leather, cutch contains a brown colouring matter; hence it is largely employed in dyeing browns with the aid of bichromate of potash, such browns having a pleasant warm tone and being very fast.

**Dextrine or British Gum**.—A product derived from starch, either by gently heating it or by the action of a very small quantity of acid. It has a pleasant but peculiar smell, a sweet taste, and is easily soluble in water, forming a thick, viscid, highly adhesive liquid. It is employed, in finishing textile fabrics, to impart a stiffness as well as a slight gloss; it is used in printing cotton, wool, and silk, as a thickener; and also as an adhesive agent in the place of gum arabic. Its solutions reduce an alkaline solution of copper tartrate (Fehling's solution), but give no blue colour with iodine.

**Divi Divi** is a tannin material very largely employed in the tanning of leather, and often in the dyeing of blacks on cotton. It is the bean pod of a small tree, the *Cæsalpinia coriaria*, which grows in South America.

**Eau de Javelle**, a solution of potassium hypochlorite, prepared by mixing solutions of bleaching powder and potassium carbonate together, and, after allowing the calcium carbonate to settle, pouring off the clear liquor. Or it may be made by passing chlorine gas into a cold solution of caustic potash. It is used to a limited extent in the bleaching of cotton.

**Epsom Salts**, the crystallised magnesium sulphate, has the formula  $MgSO_4 \cdot 7H_2O$ ; it contains 48.78 per cent. of actual sulphate and 51.22 per cent. of water.

**Ferrous Sulphate**, also known as sulphate of iron and copperas, is sold in two forms; "green copperas," bright but pale bluish-green crystals corresponding to the formula  $FeSO_4 \cdot 7H_2O$ , and containing 54.68 per cent. of ferrous sulphate and 45.32 per cent. of water; and "brown copperas," which is the green copperas after it has been exposed to the air for some time in a

damp place and so has become coated with a brown deposit of oxide of iron. Ferrous sulphate is largely used in dyeing along with logwood, fustic, &c., in the production of blacks, greys, olives, browns, &c.

**Fluoride of Chrome.**—A compound of chromium and fluorine having the formula  $\text{CrF}_3\text{H}_2\text{O}$ , which has lately been introduced as a mordanting agent for wools; as a fixing agent for such colouring matters as Titan yellow Y, Diamine fast red F, Anthracene red, Emin red, Anthracene yellow, Milling yellow, after dyeing it has proved itself very useful.

**Fustic**, a natural dyestuff, the wood of the tree known to botanists as *Morus tinctoria*. It grows very largely in Cuba, and hence is often known as Cuba wood. It is used in dyeing yellows on wool and silk with the aid of an alumina mordant; with chrome it gives olive yellows. It is largely employed in conjunction with logwood in the dyeing of blacks, and with indigo extract, the red woods, &c., in the dyeing of greens, olives, browns, &c. The colours it gives are fast to washing, but are not quite fast to light.

**Gallic Acid**, a peculiar acid found in galls.

**Galls**, these are excrescences found on oak trees which are caused by the punctures of certain insects known as gall insects. The galls contain a large proportion of tannic acid as well as some gallic acid. Being fairly free from colouring matter galls form a very convenient source for the preparation of tannic acid, while a decoction is serviceable in the mordanting of cotton with the basic coal-tar colours.

**Gambier**, the commercial name of *Catechu*, which see.

**Glauber's Salt**, the common name of crystallised sodium sulphate, which has the formula  $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ . It is largely used in wool and silk dyeing, and in the dyeing of cotton with the direct colours as an "assistant mordant," its object being to ensure a greater evenness of shade by preventing too rapid an assimilation of the dyestuff by the fibre.

**Glycerine**, a viscid, water-white liquid, having a sweet taste. It is obtained by the saponification of fats and oils. Its formula is  $\text{C}_3\text{H}_5(\text{OH})_3$ . It mixes freely with water and alcohol in all proportions and is somewhat hygroscopic in its properties. It is employed in dyeing as a solvent for certain colouring matters, and in cotton finishing to give a feeling of fulness to the cloths.

**Hydrochloric Acid**, commonly known as spirit of salt or muriatic acid, is prepared by heating salt with sulphuric acid. It is a compound of hydrogen and chlorine having the formula  $\text{HCl}$ . What is sold commercially as hydrochloric acid is a

solution of the true acid in water. The commercial acid usually has a specific gravity of 1.150 (30° Tw.) and contains 30 to 31 per cent. of actual anhydrous acid represented by the formula HCl.

**Indigo** is a colouring matter extracted by a peculiar kind of fermentation from several species of plants which are natives of India, the *Indigofera tinctoria* being the most important. Indigo itself is a solid having a bronzy blue colour and a coppery lustre, it is insoluble in water and most other solvents. In cotton dyeing and also in certain methods of dyeing wool and silk it is employed by means of the vat as it is called. Owing to its being acted upon by reducing agents, such as a mixture of copperas and lime, bisulphite of soda and zinc, &c., it undergoes reduction, and is converted into what is called indigo white which is soluble in water. If a piece of cloth or yarn be dipped into this solution and then exposed to the air, the indigo white takes up oxygen, indigo blue is reproduced and the cloth or yarn is dyed blue, the depth of colour being regulated by the amount of indigo white taken up, which is dependent upon the strength of the dye vat. By acting upon indigo with sulphuric acid it undergoes what is called sulphonation and becomes soluble in water; this solution may be employed in dyeing wool and silk in bright blue shades. Preparations of indigo made in this way are sold under the names of *Indigo extract* and *Indigo carmine*, which see.

**Indigo Carmine** is prepared by heating indigo with sulphuric acid until it becomes soluble, then adding, first, sufficient soda to neutralise the acidity; next, salt to precipitate the colouring matter, which is collected on a filter, rinsed with water, and dried. It is used in wool and silk dyeing from baths containing a little acid.

**Indigo Extract** is prepared in the same manner as indigo carmine, but the material, after neutralising with soda and precipitating with salt, is left in a paste form. Several varieties of indigo extract are recognised, such as acid extract, sweet extract, &c.; these differ very slightly from one another, and are produced by modifications in the process of making. Indigo extract is very largely employed in wool dyeing for dyeing blue shades, which it does from baths containing acid; it dyes very level shades without much trouble. It is also employed in conjunction with archil, orange, and other dyestuffs, in dyeing compound shades, greens, olives, browns, &c. In silk dyeing it is also employed for similar purposes. The shades dyed with indigo extract are not fast to light and air; they resist, however, a considerable amount of washing.

**Iron Liquor**, a crude pyrolignite of iron made from scrap iron and the pyroligneous acid obtained in the dry distillation of wood. See *Black liquor*.

**Iron Sulphate**, see *Ferrous sulphate*.

**Kieserite**, an impure magnesium sulphate, obtained as a by-product in the treatment of the potash salts found at Stassfurt, in Germany. It is largely used in the finishing of cotton cloths, and for the preparation of Epsom salts. It usually contains 60 per cent. of actual magnesium sulphate.

**Ley or Lye**, the technical name for solutions of potash and soda.

**Lime**, the oxide of the metal calcium having the formula CaO. It is prepared by calcining, in lime kilns, chalk or limestone, which are forms of carbonate of lime; in the operation of burning they lose carbonic acid gas, and what is known as quicklime is left. This has a powerful affinity for water, so that on mixing the two bodies together considerable heat is evolved and the lime becomes slaked, being converted into calcium hydroxide,  $\text{CaH}_2\text{O}_2$  in so doing. Many compounds of lime are employed in dyeing.

**Logwood**, the wood of the tree *Hæmatoxylon Campechianum*, a large tree which grows very extensively in Jamaica, Honduras, St. Domingo, and other Central American and West Indian countries. Logwood is one of the most important natural dyestuffs in use in dyeing, taking rank next to indigo in this respect. It is employed in the production of blacks, with the aid of iron and chromium mordants, on all textile fibres, dark blues, browns, olives, &c. Its supremacy for these purposes has not yet been overthrown by the coal-tar colours; still, they are now running it a very close race for the production of blacks on wool and cotton.

**Madder**, the root of the madder plant, *Rubia tinctoria*, formerly much used in the dyeing of Turkey red on cotton, but its place has now been taken by Alizarine. It is still used to a limited extent in dyeing wool and silk for reds, browns, &c.

**Magnesium Sulphate**,  $\text{MgSO}_4$ , is, in the crystallised form, commonly known as *Epsom salts*, which see; in an impure form as *Kieserite*, which see.

**Mordants**, the name given to an important class of metallic salts, used for the purpose of fixing certain natural and artificial colouring matters upon textile fibres. Such dyestuffs as are employed along with mordants have the property of forming insoluble coloured compounds with the oxides of the metals contained in the mordant used; such coloured bodies are called

colour-lakes; being quite insoluble and firmly fixed on the fibre, the latter is dyed in fast colours. The mordanting or fixing of the metallic oxide on to the textile fibre is carried out in a variety of ways, depending upon the particular mordant employed; usually it is the first step in the application of mordant dyes, as they are called, but often the mordant and dyestuff are applied at the same time, which, however, is a method which leads to a loss of colouring matter; in some cases the mordanting is done after the dyestuff has been fixed on the fibre. This latter method goes by the name of the stuffing and saddening process.

**Muriate of Ammonia**, a common name for sal ammoniac (ammonium chloride).

**Muriate of Tin**, the name given to a solution of tin in hydrochloric acid; single muriate of tin when the specific gravity ranges from 1·200 to 1·300 (40° to 60° Tw.), and double muriate if the gravity is 1·400 to 1·600 (80° to 120° Tw.). The double muriate contains from 28 to 30 per cent. of tin. It is used in dyeing with cochineal, barwood, &c., but not so much now as formerly.

**Muriatic Acid**, a common name for hydrochloric acid.

**Myrabolams**, the fruit of a tree grown in India; it is dried and exported into this country. It is rich in tannin, and, not containing much colouring matter, it is largely used in the tanning of leather and in dyeing of cotton.

**Naphthol**,  $C_{10}H_7OH$ , the phenol of the coal-tar hydrocarbon, naphthalene. There are two varieties, alpha and beta, which have the same chemical composition, but differ in the character of the dyes they yield. Naphthol is now coming largely into use as a developer in connection with the use of Primuline, Diamine blacks, and other colours for cotton, with which the modern diazotising and developing process can be adopted. Beta-naphthol tends to produce brighter shades of scarlet, &c., than does alpha-naphthol. Both are important constituents of coal-tar colours.

**Nitrate of Copper**, made by dissolving copper in nitric acid, or by precipitating a solution of copper sulphate with a solution of lead nitrate. Usually sold to dyers in a liquid form, having a specific gravity of 1·400 (80° Tw.), and containing 38 to 40 per cent. of actual nitrate of copper,  $Cu_2NO_3$ . It can also be obtained in the form of blue, somewhat deliquescent, crystals.

**Nitrate of Iron**.—Under this name there is sold to dyers a brownish-yellow liquid, made either by dissolving iron in nitric acid, or by boiling ferrous sulphate with nitric acid; in the

former case the solution contains nitrate of iron ; in the latter, it is a solution of ferric sulphate, the persulphate of iron. The specific gravity of the nitrate of iron usually sold is 1·400 ( $80^{\circ}$  Tw.), and it contains 14 per cent. of oxide of iron. It is largely used in dyeing as a mordant in the production of logwood blacks, especially on silk.

**Nitric Acid**, commonly known as *aqua fortis*, is a highly fuming, corrosive fluid ; when pure, it is colourless, but the usual commercial samples are of a straw colour, due usually to their containing oxides of nitrogen in solution. It has commonly a specific gravity of 1·400 ( $80^{\circ}$  Tw.), and contains 65 per cent. of the chemically pure acid,  $\text{HNO}_3$ .

**Oil of Vitriol**, the commercial name for sulphuric acid.

**Oleine**, a term sometimes applied to *Soluble oil*, which see.

**Orchella Weed**, a lichen weed found growing on the coasts of the lands about the Indian Ocean. They are used for the preparation of archil, cudbear, and litmus, which are used as colouring matters in dyeing. The colouring matter as such does not exist in the weed, but is formed when the weed is subjected to a peculiar species of fermentation in the presence of ammonia. See *Archil* and *Cudbear*.

**Oxalate of Antimony**, a double oxalate of antimony and potash, used as a mordant in dyeing with the basic coal-tar colours in the place of tartar emetic. It contains 21 per cent. of antimony.

**Oxalic Acid**, an organic acid found in some plants. It can be made by acting upon sugar with nitric acid, but chiefly by acting upon sawdust with caustic potash. It occurs in white crystals having the formula  $\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ . It is a powerful poison. It is used in dyeing in a variety of ways.

**Oxymuriate of Tin**, also known as permuriate or nitromuriate of tin, is a solution of stannic chloride,  $\text{SnCl}_4$ . It is usually sold in the form of a heavy liquid having a specific gravity of 1·400 ( $80^{\circ}$  Tw.), containing about 30 per cent. of tin.

**Peachwood** is the wood of a species of *Caesalpinia* growing in the Campeachy district of Central America ; it belongs to the soluble class of red woods, and is much employed in the dyeing of dark reds, browns, &c.

**Pearlash**, purified potashes, contains about 95 to 97 per cent. of potassium carbonate ; it is very much used in the making of soft soaps, in the scouring of wool, silk, &c. See *Potash*.

**Peroxide of Hydrogen**,  $\text{H}_2\text{O}_2$ , is largely employed as a bleaching agent for wool, silk, and other animal fibres. It is sold in the form of an aqueous solution of varying degrees of

strength, which are measured by the volume of oxygen they will give off when mixed with potassium permanganate; thus, a 10-volume peroxide gives off ten times its own volume of oxygen gas, a 20-volume peroxide twenty times its own volume, and so on.

**Peroxide of Sodium**,  $\text{Na}_2\text{O}_2$ , has lately come into the market as a bleaching agent in place of peroxide of hydrogen. It is sold in the form of a greyish, white, granular powder containing from 95 to 97 per cent. of sodium peroxide. When thrown upon water it dissolves with a hissing noise and the production of considerable heat, the chemical affinity between the two bodies being very great. Some care has to be made in making solutions of this body, because, if the temperature rises too high there is a liability to a loss of oxygen. By acidifying the solution with sulphuric acid, a solution of peroxide of hydrogen is obtained of greater strength than is possible to obtain by any other means; therefore, peroxide of sodium can be employed to prepare strong bleaching liquors for wool and silk. Care should be taken not to allow sodium peroxide to come in contact with wood, paper, or any combustible body, or the latter may be set on fire with disastrous results.

**Persian Berries**.—These berries are the fruit of the dyer's buckthorn, *Rhamnus infectorius*, a small tree which grows extensively in the South of France, Spain, nearly all Mediterranean States, and in Persia; the best are obtained from the latter country. Persian berries are employed in the dyeing of wool and silk for the production of yellow shades with alumina and tin mordants; chromium mordants give olive yellow shades. It is also used in calico printing. The shades yielded by Persian berries are fairly fast to washing but not to light. Berry extract and berry liquor are commercial preparations of Persian berries.

**Potassium Bichromate**, see *Bichrome*.

**Potassium Ferricyanide**, commonly known as the red prussiate of potash, has the formula  $\text{K}_3\text{FeO}_6\text{N}_6$ . It occurs in dark red crystals easily soluble in water. It is used in the production of aniline blacks and in the dyeing of blues.

**Potassium ferrocyanide**, the yellow prussiate of potash, has the formula  $\text{K}_4\text{FeC}_6\text{N}_6$ . It occurs in the form of flat yellow crystals, easily soluble in water. It is used in dyeing blacks on silk, in the production of aniline blacks, in the dyeing of blues, &c.

**Potash** is the name given to the alkaline residue which is left behind when wood and vegetable matter generally are burnt.

The name comes from the custom of treating this residue with water and boiling down the liquor to dryness in pots. The best potashes are generally known under the name pearl ash. Potash consists essentially of the carbonate of the metal potassium, and has the formula  $K_2CO_3$ ; it contains also small quantities of the hydroxide or caustic potash, as well as the sulphate, chloride, &c.

**Pyroligneous Acid**, the name given to the crude acetic acid obtained during the dry distillation of wood. Besides acetic acid it contains a variety of other products to which is due its dark colour and its peculiar odour. It is employed in the preparation of crude acetates, some of which are employed in dyeing.

**Quercitron Bark**, or **Bark**, is the bark obtained from a species of oak growing in North America, known to botanists as the *Quercus infectorius*. It is employed along with tin and alumina mordants in the dyeing of yellows, olives, browns, &c. The shades it dyes are not fast to light, but they resist washing very well.

**Red Argols**, crude potassium tartrate.

**Red Liquor** is an impure acetate of alumina made by mixing a solution of alum with a solution of brown sugar of lead or one of brown acetate of lime. It is usually sold of a specific gravity of 1·110 (22° Tw.) which contains 4 per cent. of alumina.

**Red Prussiate of Potash**, the potassium ferricyanide,  $K_3FeC_6N_6$ .

**Refined Alkali** is the nearly pure sodium carbonate,  $Na_2CO_3$ ; it contains about 98 per cent. of the carbonate.

**Sal Ammoniac**, the common name of ammonium chloride.

**Salt Cake** is an impure sodium sulphate, obtained by treating salt with sulphuric acid. It contains about 98 per cent. of sodium sulphate,  $Na_2SO_4$ .

**Scarlet Liquor** is a crude acetate of alumina made in the same way as red liquor.

**Soap** is a chemical combination of a fat and an alkali. A hard soap is obtained if soda be the alkali employed and a soft soap when potash is the alkali. A very great variety of fatty and oily bodies may be, and are, employed in the preparation of soap; but it is not needful here to go very fully into the question of what ingredients are used in soap making. Soap is employed by the garment cleaner and dyer for a variety of purposes; in scouring or cleansing of garments, in the dyeing of silks, in the clearing of colours after dyeing, &c. For the purposes of the garment cleaner and dyer, a soap should be of good quality, free from any rancid odour, or any tendency to go

rancid. It should be soluble without much difficulty in water, and free from excess of either alkali or fat, or, in other words, quite neutral. A good make of hard soap will contain from 65 to 70 per cent. of fatty matter, 6 to 7 per cent. of alkali, and 22 to 28 per cent. of water. The quality of soaps has already been referred to in the text.

**Soda**, the name originally given and now commonly applied to the crystallised sodium carbonate, the washing soda of the laundress. It is also applied in technical works to the oxide of sodium and, frequently, also to caustic soda.

**Soda Ash** is the crude carbonate of soda obtained in the Leblanc soda process. It is sold at prices proportionate to the actual amount of carbonate it contains, its strength, however, being measured by the percentage of sodium oxide,  $\text{Na}_2\text{O}$ ; thus there is 48 per cent. ash, 50 per cent., 58 per cent., &c.; 58 per cent. is the strongest that is made, and corresponds to nearly pure alkali, containing from 98 to 99 per cent. of actual sodium carbonate.

**Soda Crystals**, the crystallised sodium carbonate, containing 10 molecules of water of crystallisation, and having the formula  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ . It contains 37·07 per cent. of sodium carbonate and 62·93 per cent. of water. "Soda crystals" is also known as washing soda and as sal soda. Its uses are many and various.

**Soluble Oil** is the name given to oily preparations made from castor oil in two ways. First by saponification with caustic soda or caustic potash, by careful adjustment of the proportions of oil and alkali and water, an oily product is obtained; this was the original soluble oil. Of late years, however, it has been largely replaced with the article made by the second method which consists in treating castor oil with strong sulphuric acid; then, after washing out the excess of acid with water, neutralising the residual oil with either caustic soda or with ammonia. The product so obtained has a very oily appearance, and is quite soluble in water. It is made of varying degrees of quality, which is measured by the amount of oil actually contained in it, the usual strengths being 25, 50, and 75 per cent. This product is also known as Oleine, Alizarine red oil, Turkey red oil, &c. It is extensively used in the dyeing and printing of cotton goods, and also in the finishing of textile fabrics.

**Spirit of Salts**, a common name for hydrochloric acid.

**Stannate of Soda**, a compound of the oxides of tin and sodium, having the formula  $\text{Na}_2\text{SnO}_3$ , used in dyeing and printing of cotton with the azo colouring matters. It is sold in three forms — (a) as a solution having a specific gravity of 1·20

(50° Tw.), and containing about 10 per cent. of actual stannate ; (b) as a powder containing about 28 per cent. of actual stannate ; and (c) as crystals containing 42 to 44 per cent. of oxide of tin,  $\text{SnO}_2$ , equal to 61 to 64 per cent. of stannate.

**Sugar of Lead**, the common name for acetate of lead.

**Sulphate of Alumina**,  $\text{Al}_2\text{SO}_4$ , is now largely used as a mordant for cotton in dyeing with Alizarine and similar dye-stuffs. It is rather more soluble than alum, and gives equally good results. It contains usually from 15 to 17 per cent. of alumina.

**Sulphocyanide of Alumina**,  $\text{Al}_3\text{SCN}$ , is a mordant used in printing cotton with Alizarine. It is prepared by mixing solutions of barium sulphocyanide and sulphate of alumina together and allowing the precipitate of barium sulphate to settle ; the clear liquor is the required mordant.

**Sulphur**, an elementary body having the symbol S, used in bleaching wool, silk, straw, &c. It is sold in two forms—lump, under the name of brimstone ; powder, under the name of flowers of sulphur. It is combustible, burning with a pale blue lambent flame and evolving rather suffocating vapours of sulphur dioxide (sulphurous acid) gas.

**Sulphuric Acid**, which has the formula  $\text{H}_2\text{SO}_4$ , is an oily liquid, having a specific gravity of 1.840 (168° Tw.), which contains about 98 per cent. of actual acid. It is the most powerful acid known as well as the most important. It is largely employed in the dyeing, printing, and bleaching of textile fabrics. It has a considerable affinity for water, which it will absorb from the atmosphere, and on mixing the two fluids together great heat is evolved, which renders it desirable that care should be exercised in bringing the water and acid together. Sulphuric acid is commonly known by the name of oil of vitriol, or, shortly, vitriol.

**Sulphurous Acid**, or more properly sulphur dioxide, gas, which has the formula  $\text{SO}_2$ , is one of the most important bleaching agents known, and is largely employed in the bleaching of wool, silk, and other animal fibres. It is generally produced by the combustion of sulphur, as described in the text. By combination with metals sulphurous acid forms sulphites, many of which are used in bleaching and dyeing.

**Tannin** is an impure tannic acid employed as a mordant in the dyeing of cotton with the basic coal-tar colours, also in weighting silk, &c.

**Tartar**, the deposit, consisting of the acid tartrate of potash,  $\text{KHC}_4\text{H}_4\text{O}_6$ , which forms in the vats in which grape juice is

undergoing fermentation in wine making. When purified it is known as cream of tartar. This body is largely employed in the mordanting of wool and silk for dyeing with the Alizarine class of colouring matters.

**Tartar Emetic**, the double tartrate of antimony and potash having the formula  $\text{KSbOC}_4\text{H}_4\text{O}_6$ , and containing 35.56 per cent. of antimony. It is largely used in the mordanting of cotton for dyeing with the basic coal-tar colours, its purpose being to fix the tannic acid as an insoluble tannate on the fibre.

**Tin Crystals**, or tin salt, the common name of stannous chloride,  $\text{SnCl}_2$ . The commercial article usually contains 84 per cent. of actual tin chloride, and 16 per cent. of water of crystallisation.

**Tin Spirits** are solutions of tin in hydrochloric acid, or in nitric acid, or in a mixture of the two acids. They consist chiefly of stannous chloride, although some contain stannic chloride. They are going out of use.

**Turkey Red Oil**, see *Soluble Oil*.

**Turmeric**, the root of a plant, *Curcuma longa*, which grows in India, China, &c. It contains a yellow colouring principle which has a natural affinity for the cotton fibre. It is employed in the dyeing of cotton, wool, and silk, and does not require any mordant; although with alumina, chrome, &c., it forms colour lakes.

**Turpentine** is an hydrocarbon compound, having the formula  $\text{C}_{10}\text{H}_{16}$ , which occurs naturally in the resinous exudations from various trees, notably in the coniferous trees; from these resinous exudations it is obtained by distillation with steam. It is a water-white liquid, having a peculiar and characteristic odour, and inflammable, burning with a smoky flame. It is insoluble in water, but mixes freely with alcohol, naphtha, and other solvents. It dissolves resins, oils, fats, &c. It is employed in garment cleaning for freeing the goods from oil, and especially from paint. It has a specific gravity of 0.867, boils at 160° C., and has a flash point of 97° F.

**Valonia**, the acorn cups of various species of oak trees, especially of the *Quercus aegilops*, which grow in Asia Minor. Valonia is used chiefly on account of the tannin it contains, and finds employment in silk dyeing, cotton dyeing, and as a source of tannin.

**Weld** is the plant *Reseda luteola*, the dyer's weld, which used to be grown very extensively in England. It yields, with tin mordants, bright yellows; and, with alumina mordants, greenish-

yellow shades on wool and silk. These shades are very fast to light. Weld has almost gone out of use as a dyestuff.

**White Vitriol**, the common name for zinc sulphate.

Woad is the name of a plant, *Isatis sativa*, formerly largely cultivated in England, which contains a blue colouring principle, allied to, if not identical with, indigo. Formerly it was much used in dyeing blues on cotton, wool, &c. It is used in the preparation of indigo vats.

**Yellow Prussiate of Potash**, the common name for potassium ferrocyanide.

Zinc Sulphate or white vitriol has the formula,  $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ ; it contains 56.09 per cent. of zinc sulphate and 53.91 per cent. of water of crystallisation. It is not much used in dyeing.

## APPENDIX B.

## HYDROMETER TABLE.

Degrees Beaume.	Degrees Twaddell.	Specific gravity.	Degrees Beaume.	Degrees Twaddell.	Specific gravity.
1	1·4	1·007	34	61·6	1·308
2	2·8	1·014	35	64·0	1·320
3	4·4	1·022	36	66·4	1·332
4	5·8	1·029	37	69·0	1·345
5	7·4	1·037	38	71·4	1·357
6	9·0	1·045	39	74·0	1·370
7	10·2	1·052	40	76·6	1·383
8	12·0	1·060	41	79·4	1·397
9	13·4	1·067	42	82·0	1·410
10	15·0	1·075	43	84·8	1·424
11	16·6	1·083	44	87·6	1·438
12	18·2	1·091	45	90·6	1·453
13	20·0	1·100	46	93·6	1·468
14	21·6	1·108	47	96·6	1·483
15	23·2	1·116	48	99·6	1·498
16	25·0	1·125	49	103·0	1·515
17	26·8	1·134	50	106·0	1·530
18	28·4	1·142	51	109·2	1·546
19	30·4	1·152	52	112·6	1·563
20	32·4	1·162	53	116·0	1·580
21	34·2	1·171	54	123·0	1·615
22	36·0	1·180	55	127·0	1·635
23	38·0	1·190	56	130·4	1·650
24	40·0	1·200	57	134·2	1·671
25	42·0	1·210	58	138·2	1·691
26	44·0	1·220	59	142·0	1·710
27	46·2	1·231	60	146·4	1·732
28	48·2	1·241	61	150·0	1·753
29	50·4	1·252	62	155·0	1·775
30	52·6	1·263	63	159·0	1·795
31	54·8	1·274	64	164·0	1·820
32	57·0	1·285	65	168·4	1·842
33	59·4	1·297	66	173·0	1·865

To convert Twaddell degrees into actual specific gravity, multiply the number of degrees by 5 and prefix 1·—thus, 132° Tw. is  $132 \times 5 = 660 = 1\cdot660$  specific gravity, 1·0 should be added when the degrees are below 20.

To reduce actual specific gravity to Twaddell degrees, divide the decimal figures by 5—thus, 1·248 is  $248 \div 5 = 49\cdot6^{\circ}$  Tw.

## APPENDIX C.

## COMPARISON OF TEMPERATURE DEGREES.

C = Celsius or Centigrade. F = Fahrenheit.

C.	F.	C.	F.	C.	F.	C.	F.
-17	+1·4	+13	+55·4	+43	+109·4	+72	+161·6
16	3·2	14	57·2	44	111·2	73	163·4
15	5	15	59	45	113	74	165·2
14	6·8	16	60·8	46	114·8	75	167
13	8·6	17	62·6	47	116·6	76	168·8
12	10·4	18	64·4	48	118·4	77	170·6
11	12·2	19	66·2	49	120·2	78	172·4
10	14	20	68	50	122	79	174·2
9	15·8	21	69·8	51	123·8	80	176
8	17·6	22	71·6	52	125·6	81	177·8
7	19·4	23	73·4	53	127·4	82	179·6
6	21·2	24	75·2	54	129·2	83	181·4
5	23	25	77	55	131	84	183·2
4	24·8	26	78·8	56	132·8	85	185
3	26·6	27	80·6	57	134·6	86	186·8
2	28·4	28	82·4	58	136·4	87	188·6
1	30·2	29	84·2	59	138·2	88	190·4
* 0	32	30	86	60	140	89	192·2
+ 1	33·8	31	87·8	61	141·8	90	194
2	35·6	32	89·6	62	143·6	91	195·8
3	37·4	33	91·4	63	145·4	92	197·6
4	39·2	34	93·2	64	147·2	93	199·4
5	41	35	95	65	149	94	201·2
6	42·8	36	96·8	66	150·8	95	203
7	44·6	37	98·6	67	152·6	96	204·8
8	46·4	38	100·5	68	154·4	97	206·6
9	48·2	39	102·2	69	156·2	98	208·4
10	50	40	104	70	158	99	210·2
11	51·8	41	105·8	71	159·8	†100	212
12	53·6	42	107·6				

\* Freezing point.

† Boiling point.

## RULES FOR CONVERTING TEMPERATURES FROM ONE SCALE TO ANOTHER.

(a) *To convert Centigrade into Fahrenheit degrees.*

Multiply the degree by 9, divide the result by 5, and add 32. For example, 36° C. into F. :—

$$36^\circ \times 9 = 324; 324 \div 5 = 64.8; 64.8 + 32 = 96.8^\circ \text{F.}$$

In the case of temperatures below the freezing point, 0° of the Centigrade scale, the rule is to multiply by 9, divide the result by 5, take the difference between the number so obtained and 32; if it be the larger number add the sign — to the result, if the smaller add the sign +. The following examples illustrate these rules:—

$$(1) - 8^\circ \text{C. to F., and (2)} - 40^\circ \text{C. to F.}$$

$$(1) 8 \times 9 = 72; 72 \div 5 = 14.4; 32 - 14.4 = + 17.6^\circ \text{F.}$$

$$(2) 40 \times 9 = 360; 360 \div 5 = 72; 72 - 32 = - 40^\circ \text{F.}$$

(b) *To convert Fahrenheit degrees into Centigrade degrees.*

Subtract 32, multiply the result by 5, and divide this second result by 9. Thus, convert 82° F. into C. degrees :—

$$82 - 32 = 50; 50 \times 5 = 250; 250 \div 9 = 27.8^\circ \text{C.}$$

When the temperatures are between 32° and 0° F., take the difference between 32 and the degree and proceed as before, adding a — sign to the result. For example, reduce 24° F. to C. degrees :—

$$32 - 24 = 8; 8 \times 5 = 40; 40 \div 9 = 4.4 = - 4.4^\circ \text{C.}$$

If below 0° F., add 32 to the degree and proceed as before, adding a — sign to the result. For example, reduce - 18° F. to C. degrees :—

$$- 18 + 32 = 14; 14 \times 5 = 70; 70 \div 9 = 7.8 = - 7.8^\circ \text{C.}$$

## APPENDIX D.

TABLES FOR CONVERTING FRENCH METRIC WEIGHTS AND MEASURES  
INTO ENGLISH WEIGHTS AND MEASURES.

## A. WEIGHTS.

French.	English.			French.	English.		
Grammes.	Lbs.	Ozs.	Grains.	Grammes.	Lbs.	Ozs.	Grains.
1	...	...	15·432	60	...	2	48·908
2	...	...	30·864	70	...	2 $\frac{1}{4}$	93·851
3	...	...	46·296	80	...	2 $\frac{3}{4}$	31·319
4	...	...	61·728	90	...	3	75·362
5	...	...	77·160	100	...	3 $\frac{1}{2}$	9·930
6	...	...	92·592	200	...	7	19·860
7	...	...	108·024	300	...	10 $\frac{1}{2}$	29·790
8	...	$\frac{1}{4}$	14·079	400	...	14	39·720
9	...	$\frac{1}{4}$	29·511	500	1	1 $\frac{1}{2}$	49·650
10	...	$\frac{1}{4}$	44·943	600	1	5	59·580
20	...	$\frac{1}{2}$	89·886	700	1	8 $\frac{1}{2}$	69·510
30	...	1	24·454	800	1	12	79·440
40	...	$1\frac{1}{4}$	70·397	900	1	15 $\frac{1}{2}$	89·370
50	...	$1\frac{3}{4}$	4·965	1000	2	3	99·300

1,000 grammes . . . = 1 kilo.

1,000 kilos . . . = 19 cwts. 2 qrs. 21 lbs.

English.	French.
1 ton . . . .	= 1,016 kilos.
1 cwt. . . . .	= 50·80 kilos.
1 qr. . . . .	= 12·70 kilos.
1 lb. . . . .	= 454 grammes.
1 oz. . . . .	= 28·3 grammes.

To reduce ounces to grammes, multiply by 28·3.

To reduce grains to grammes, multiply by 0·0648.

## B. LENGTH.

French.	English.	French.	English.
1 millimetre	= 0·0393 inch.	30 centimetres	= 11·81 inches.
2 ,,"	= 0·0787 ,,"	40 ,,"	= 15·74 ,,"
3 ,,"	= 0·1181 ,,"	50 ,,"	= 19·68 ,,"
4 ,,"	= 0·1574 ,,"	60 ,,"	= 23·62 ,,"
5 ,,"	= 0·1968 ,,"	70 ,,"	= 27·56 ,,"
6 ,,"	= 0·2362 ,,"	80 ,,"	= 31·5 ,,"
7 ,,"	= 0·2756 ,,"	90 ,,"	= 35·43 ,,"
8 ,,"	= 0·3150 ,,"	100 ,,"	= 39·37 ,,"
9 ,,"	= 0·3543 ,,"	1 metre	= 39·3707 ,,"
10 ,,"	= 0·3937 ,,"	1 ,,"	= 3·280 feet.
25 ,,"	= 1 inch nearly.	1 ,,"	= 1·0936 yard.
10 centimetres	= 4 inches nearly.	1 kilometre	= 1093·63 yards.
20 ,,"	= 7·87 inches.	1 ,,"	= 0·6214 mile.

English.	French.
1 inch	= 25·39 millimetres.
1 foot	= 30·479 centimetres.
1 yard	= 0·9144 metre.
1 mile	= 1·609 kilometres.

To reduce centimetres to inches, multiply by 0·3937.

To reduce inches to metres, multiply by 0·0254.

To reduce inches to centimetres, multiply by 2·54.

## C. CAPACITY.

French.	English.
1 cubic centimetre (c.c.)	= '061 cubic inch.
1 ,,"	= '0352 fluid oz. = $\frac{1}{3}$ fluid drachm nearly.
2 ,,"	= 0·0704 ,," = $\frac{2}{3}$ ,," ,,"
3 ,,"	= '1156 ,," = 1 ,," ,,"
4 ,,"	= 1408 ,," = $1\frac{1}{2}$ ,," ,,"
5 ,,"	= '1760 ,," = $1\frac{2}{3}$ ,," ,,"
6 ,,"	= '2112 ,," = $1\frac{3}{4}$ ,," ,,"
7 ,,"	= '2464 ,," = 2 ,," ,,"
8 ,,"	= '2816 ,," = $2\frac{1}{3}$ ,," ,,"
9 ,,"	= 3168 ,," = $2\frac{2}{3}$ ,," ,,"
10 ,,"	= '352 ,," = 3 ,," ,,"
28 ,,"	= 1 fluid oz. nearly.
1 litre . . . .	= 35·215 fluid ozs. = 1·76 pints.
2 ,," . . . .	= 70·430 ,," = 3·52 ,,"
3 ,," . . . .	= 105·646 ,," = 5·28 ,,"
4 ,," . . . .	= 140·861 ,," = 7·04 ,,"
5 ,," . . . .	= 176·077 ,," = 8·80 ,,"
6 ,," . . . .	= 211·292 ,," = 10·56 ,,"
7 ,," . . . .	= 246·507 ,," = 12·32 ,,"
8 ,," . . . .	= 281·723 ,," = 14·08 ,,"
9 ,," . . . .	= 316·938 ,," = 15·84 ,,"
10 ,," . . . .	= 352·154 ,," = 17·60 ,,"

French.	English.
20 litres . . .	= 4 gallons $1\frac{1}{4}$ pints.
30 ,, . . .	= 6 ,, $4\frac{3}{4}$ ,,
40 ,, . . .	= 8 ,, $6\frac{1}{2}$ ,,
50 ,, . . .	= 11 ,,
60 ,, . . .	= 13 ,, $1\frac{3}{4}$ ,,
70 ,, . . .	= 15 ,, $3\frac{1}{4}$ ,,
80 ,, . . .	= 17 ,, $4\frac{3}{4}$ ,,
90 ,, . . .	= 19 ,, $6\frac{1}{2}$ ,,
100 ,, . . .	= 22 ,,
1 cubic metre. . .	= 35.316 cubic feet.

English.	French.
1 cubic inch . . .	= 16.386 cubic centimetres.
1 cubic foot . . .	= 28.315 litres.
1 fluid drachm . .	= 3.55 cubic centimetres.
1 fluid oz. . .	= 28.39 ,, ,,,
1 pint . . .	= 567.9 ,, ,,,
1 quart . . .	= 1.136 litres. ,,,
1 gallon . . .	= 4.548 ,,

To reduce litres to gallons, multiply by 0.22.

To reduce pints to cubic centimetres, multiply by 567.936.

To reduce gallons to litres, multiply by 4.548.

## APPENDIX E.

## DRY DYEING.

A SYSTEM of dyeing, which is somewhat curiously named dry dyeing, has of late been proposed for the treatment of garments of various kinds ; the idea which underlies it is to do away with water as the vehicle in which the dyes are dissolved and conveyed to the fabric, and so prevent the shrinking which inevitably follows dyeing with water, especially in the case of woollen goods. The vehicle employed in the new system is benzine or petroleum spirit, but as few of the coal-tar colours are soluble in that vehicle, they must previously be treated with some agent that will render them soluble in petroleum spirit. This can be effected by heating the dyes with oleic acid or stearic acid, which dissolves them and carries them into solution in the spirit. The solution so prepared acts as the dye bath ; there may be added to it, if necessary, a little ammonia or a little sulphuric ether. The goods are immersed in the bath until they have become dyed of the required shade, when they are taken out, wrung and dried.

In place of benzine, methylated spirit may be used ; the only disadvantages are its greater cost and the fact that the rate of dyeing is slower.

The best dyes to use in this dry method of dyeing are the basic coal-tar colours, because these are the most freely soluble in the fatty acids (oleic and stearic) employed, forming solutions of a colour similar to that they will dye the fabric. The direct series of dyes is not so serviceable, nor are the azo colours, while the mordant dyes cannot possibly be used. The affinity of the wool or the silk fibre for the basic aniline colours is sufficient to enable them to absorb the dye or colour from simple solutions ; while, in the case of the acid and azo colours, it is necessary to employ an acid dye bath to dye the fibres, and it is by no means easy to acidify a bath of benzine or petroleum spirit.

There does not appear to the author to be any material advantage in the dry method over the old method, while the range of shades which can be dyed is but limited.

## APPENDIX F.

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CARBON TETRACHLORIDE.

THE chief advantage of benzoline or benzol for garment cleaning lies in their cheapness and great solvent powers, but they possess a serious disadvantage in being so inflammable that explosions and fires have occurred, and are liable to occur, by their use. Carbon tetrachloride has, in recent years, been tried for garment cleaning; it has the great advantage of being non-inflammable and non-explosive, but, on the other hand, it is expensive. Moreover, as it is much heavier than benzoline or benzol, more is required to carry on the work, and there is a greater loss during working. It is quite as efficient as the other bodies as a solvent for fats, &c., and hence as a cleaner. Should the price of carbon tetrachloride become lower it will be worth the while of the garment cleaner to pay some attention to it.

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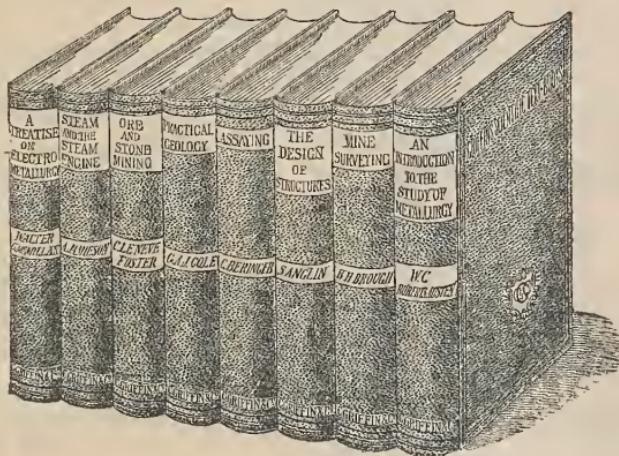
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